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MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE FINANCIAL STATUS OF COLLEGE TEACHERS[1]

IN 1908 the Foundation reported in its second bulletin the results of an enquiry concerning the financial status of the teaching staff of higher institutions in America and Germany. An examination of salary schedules for the year 1912–13 makes it possible to treat certain of the topics of that bulletin more fully and to measure the change in salaries during the past five years.

THE VARIABILITY OF SALARIES IN THE SAME INSTITUTION

A small institution performing a fairly unified educational service, such as giving instruction in the traditional academic subjects, or training engineers, or teaching law, may do its work conveniently with a staff of men graded rather sharply as, say, professors, assistant professors and instructors, with a fixed salary attached to each grade or title. The teaching staff may even be on almost absolute financial equality, four fifths of its members being "professors" and doing the work of teaching with here and there an assistant of lower title and salary.

Such simple fiscal arrangements were common a generation ago; they still persist in some of the older and smaller colleges; but they are now becoming obsolete, and no one can understand the financial sta-

[1] Based upon a study by Professor Edward L. Thorndike, of Teachers College, Columbia University, of reports made by the institutions to the Foundation. From the eighth Annual Report of the President of the Carnegie Foundation for the Advancement of Teaching.

tistics of our higher institutions by thinking of the teaching staff as sharply graded by a few academic titles, and of each title as significant of a given salary. Where there are professional schools, the salary attached to the title of professor may, in the same institution, range from $500 to a maximum of $5,000, there being actually twenty-five different sums received as annual salaries by the full professors in a single American university. In this institution thirteen different sums, ranging from $750 to $4,000, were received by persons who held the title of associate professor; fourteen different sums, ranging from $1,800 to $3,600, by assistant professors; and eighteen different sums, ranging from $200 to $2,000, by instructors. There were also clinical professors, clinical instructors, and several other academic grades causing further variability, and within each of these grades there was a still further variability of its own.

Even where there are no professional schools, the variation of salary is very great. For example, in two institutions without professional schools nineteen different sums, ranging from $2,000 to $5,000, were received by professors; thirteen different sums, ranging from $600 to $1,700, by instructors; and sixteen different sums, ranging from $1,000 to $3,000, by officers of intermediate grades. This variation is for the salaries of men—were women included, it would be greater. So far as could be ascertained, all of the salaries considered, except perhaps some of those for instructors, were for the full year's work of full-time teaching. There were both lower and higher salaries than those mentioned, but these were for exceptional conditions, as of part-time teaching or administrative work.

Both institutions illustrate the overlapping of academic grades with respect to salary. Over one fourth of the teachers of intermediate grade receive salaries as high as, or higher than, the lowest full professor's salary; nearly one fourth of the instructors receive salaries reaching or passing the lowest point for salaries of teachers of intermediate grade. Such overlapping is in no sense exceptional; in the larger institutions the fact that certain individuals of lower rank receive more salary than other individuals of higher rank is so frequent as to be almost the rule.

The Salaries of the Teaching Staff of Colleges and Universities in 1912–13

Such variability of salary for the same academic grade, either by the separation into distinct salary steps or by a gradual ranging, together with the overlapping of academic grades in salary, make the financial statistics of higher institutions difficult to present and interpret without misleading. The difficulty is increased by the differences in practise between institutions and between the same institution in different years, with respect to the significance of a given academic rank. For example, associate professors may be far above assistant professors in dignity and salary in one institution and in another be substantially on a level with them. The average salary of assistant professors may appear to have been lowered between 1907–08 and 1912–13, when in reality such service was better rewarded than before by the addition of a higher intermediate grade or title for those performing this service, and the relegation of the title of assistant professor to those performing a different service. Other complexities are added by differences in policy as to the distribution of salaries within the same grade, differences in the services performed by different individuals of the same grade, and the like.

The only sound and adequate basis for

a statement of the financial status of the teacher in a higher institution is a list of names, giving in each case salary, age, absence and pension rights, services performed, services permitted outside the institution, amount of training, and amount of experience in the institution and elsewhere. No college or university publishes such a list, and it is doubtful whether any governing board keeps such a systematic list, though it is precisely these facts that a competent head of department or college president has in mind and combines with his knowledge of the teacher's scholarship, efficiency and devotion in recommending financial provisions. It is a regrettable fact that at present we know far more about such topics as the relation of age to salary, or of length of experience to salary, in the case of elementary and high school teachers than in the case of college teachers. Indeed, the published facts for the last are practically limited to the survey made in the bulletin of the foundation to which reference has been made.

The first step obviously is to provide knowledge of the salaries that are actually paid, and this the foundation is enabled to do, through the courtesy of institutions in submitting their pay-rolls for study. As the common statements of average salaries give such imperfect and misleading notions, the detailed distribution of the relative frequencies of each salary has been studied.[2]

The facts as reported are not offered as infallible in every respect. The foundation was unwilling to impose on the institutions concerned the burden of answering detailed questions; consequently a salary may occasionally be recorded as smaller than it really was (because the individual was on leave of absence for part of the year, or was in receipt of an added payment under another department), or as larger than it really was (because a payment recorded on the pay-roll in a second department was actually included in the first payment recorded). Some mistakes of copying in and from the pay-rolls and in further tabulations are probably inevitable. The facts reported give, however, a thoroughly trustworthy general picture of what they attempt to present.

The facts compiled are for salaries in 1907–08 as well as in 1912–13, permitting measurements of the rise of salaries as well as of the present status. They are arranged

[2] Some thirty group tables were made for the following colleges and universities: *Group 1*, Carleton College, Franklin College and Ripon College; *Group 2*, Bates College, Clarkson School of Technology, Drury College, Grinnell College, Lawrence College and Mount Holyoke College; *Group 3*, Drake University and Newcomb College (of Tulane University); *Group 4*, Beloit College, Centre College of Kentucky, Dickinson College, Hobart College, Marietta College and Wabash College; *Group 5*, Hamilton College, Oberlin College, University of Pittsburgh, Tufts College and Washington and Jefferson College; *Group 6*, Middlebury College, University of Rochester, University of Vermont and Wellesley College; *Group 7*, Bowdoin College, Clark College, Indiana University, Purdue University, Swarthmore College, Trinity College (Connecticut) and Union College; *Group 8*, Dartmouth College, University of Missouri and Worcester Polytechnic Institute; *Group 9*, Lehigh University, University of Minnesota, Tulane University, Washington University (Missouri) and Western Reserve University; *Group 10*, University of Cincinnati and Vassar College; *Group 11*, Amherst College, University of Virginia and Williams College; *Group 12*, Cornell University, University of Michigan and University of Wisconsin; *Group 13*, Case School of Applied Science, Rensselaer Polytechnic Institute and Stevens Institute of Technology; *Group 14*, University of California, Massachusetts Institute of Technology and University of Toronto; *Group 15*, Johns Hopkins University, Leland Stanford Junior University, Princeton University and Yale University; *Group 16*, Columbia University and Harvard University. None of these group tables is here published, but the foundation will be glad to make them available to scholars.

in four divisions—salaries for instructors or tutors or whatever grade represents approximately the first rank of teachers with a full program, salaries for full professors, salaries for standard intermediate grades, and salaries for all of these grades combined. The salaries of assistants, or whatever grade represents approximately the work of men who are primarily students, are not included. The salaries of irregular grades, such as lecturer, which may carry an instructor's work or a part-time professor's work, or signify casual visits, or a dignified assistantship, are likewise excluded. Presidents are also excluded, but deans and directors of schools or departments are included. Teachers in medical schools, dental schools and schools of pharmacy are also excluded, being more fitly made the subject of separate study. Payments for work in summer schools are excluded. The salary of a teacher in service for only one semester is recorded as it would be for a full year's service. The aim is to show the recompense given for what is a teacher's full service in any institution in question. Although there are doubtless occasional failures to make the necessary distinctions precisely, the tables show the typical with adequate precision. In the salary scales, which form parts of the table, \$400 means from \$350 to \$449, \$500 means from \$450 to \$549, \$600 means from \$550 to \$649, and so on.

Upon examination of Table I. it will be seen that the institutions do not differ very greatly in the salaries given to instructors. We may, without serious error, group all these salaries for all institutions. The low-salaried institutions pay in the main from \$750 to \$1,200, the others from \$750 to \$1,500. It must be remembered that some of the instructors in the larger institutions included in these tables, though carrying a full program of class teaching, are really of the apprentice type, engaged in study for a higher degree. The instructor in these colleges is somewhat better paid than the male teachers in American high schools. The median salary for the latter is \$900; the average salary, little if any over \$1,000; and the proportion of salaries at \$500 to \$900 much greater. It is perhaps worthy of mention that the salaries of the mechanics employed in university shops and laboratories are distinctly below the average instructor's salary in the same institution. Fuller analysis of the financial status of the instructor must be delayed until enough individual life-histories of college teachers are available to permit the correlation of salary with age, experience in teaching, and amount of education received in preparation for teaching.

In the salaries attached to intermediate grades, associate professors, and assistant professors, institutions differ more widely. The gradation is rather steady, so that any grouping of the institutions has to be somewhat arbitrary, and its results are necessarily less instructive. There are groups of institutions with average salaries for the intermediate grades of \$1,200 to \$1,400; with average salaries of \$1,488, \$1,537 and \$1,571; with average salaries of \$1,747 to \$2,076; and lastly the Harvard-Columbia group with average salaries still higher.

These summaries appear in Table II. There are no clear "species" of teachers in this grade from the fiscal point of view. By reason of age, ability and differences in the significance of the titles concerned, the salaries spread from \$1,000 to \$4,000 with no close grouping around specially frequent salaries, save perhaps around \$1,500 for the colleges of moderate salary-schedules. If the grade of associate professor had been kept separate throughout, there would have been a somewhat, but not much, closer

TABLE I

THE SALARIES OF INSTRUCTORS IN 1912–13

Annual Salary	In Group A[3]		In Group B[4]		In Group C[5]		In All Institutions Combined	
	Gross Frequency	Percentile Frequency	Gross Frequency	Percentile Frequency	Gross Frequency	Percentile Frequency	Gross Frequency	Percentile Frequency
$400	1	.9					1	.1
500	2	1.7	1	.1	1	.3	4	.3
600	3	2.6	5	.6	6	1.5	14	1.0
700	2	1.7	24	2.8	6	1.5	32	2.3
800	14	12.0	68	7.9	22	5.5	104	7.5
900	11	9.4	66	7.6	11	2.8	88	6.4
1,000	40	34.2	219	25.3	90	22.6	349	25.3
1,100	10	8.5	112	13.0	16	4.0	138	10.0
1,200	22	18.8	142	16.4	68	17.1	232	16.8
1,300	2	1.7	81	9.4	41	10.3	124	9.0
1,400	7	6.0	87	10.1	39	9.8	133	9.6
1,500	1	.9	40	4.6	54	13.6	95	6.9
1,600	2	1.7	8	.9	15	3.8	25	1.8
1,700			4	.5	5	1.3	9	.7
1,800			1	.1	10	2.5	11	.8
1,900			2	.2	1	.3	3	.2
2,000			2	.2	12	3.0	14	1.0
2,100								
2,200			1	.1			1	.1
2,300			1	.1			1	.1
2,400								
2,500			1	.1	1	.3	2	.1
Number of individuals	117		865		398		1,380	
Average salary	$1,027		$1,121		$1,238		$1,147	
Median salary	$1,000		$1,100		$1,200		$1,100	

clustering around central points in the case of either grade. In the case of Columbia and Harvard, where the grade of associate professor is distinctly superior in

[3] Group A includes Carleton, Franklin, Ripon, Bates, Clarkson, Drury, Grinnell, Lawrence, Mount Holyoke, Drake, Newcomb, Beloit, Centre, Dickson, Hobart, Marietta, Wabash, Hamilton, Oberlin, Pittsburgh, Tufts and Washington and Jefferson.

[4] Group B includes Middlebury, Rochester, Vermont, Wellesley, Bowdoin, Clark (Collegiate), Indiana, Purdue, Swarthmore, Trinity (Connecticut), Union, Dartmouth, Missouri, Worcester Polytechnic, Lehigh, Minnesota, Tulane, Washington (Missouri), Western Reserve, Cincinnati, Vassar, Amherst, Virginia, Williams, Cornell, Michigan, Wisconsin, Case, Rensselaer and Stevens.

[5] Group C includes California, Massachusetts Institute of Technology, Toronto, Johns Hopkins, Leland Stanford, Princeton, Yale, Harvard and Columbia.

TABLE II

SALARIES OF COLLEGE TEACHERS OF INTERMEDIATE GRADE IN 1912–13

Associate Professors, Assistant Professors and Preceptors; Junior Professors in the University of Michigan

Annual Salary	In Institution Groups in Which the Average Salary for This Grade is $1,200 to $1,400[6]		In Institution Groups in Which the Average Salary for This Grade is $1,488 to $1,561[7]		In Institution Groups in Which the Average Salary for This Grade is $1,747 to $2,076[8]		In Columbia and Harvard Universities	
	Gross Frequency	Percentile Frequency	Gross Frequency	Percentile Frequency	Gross Frequency	Percentile Frequency	Gross Frequency	Percentile Frequency
$800	1	1.6						
900								
1,000	5	7.9	2	1.5	6	.7		
1,100	6	9.5	2	1.5	2	.2		
1,200	17	27.0	16	8.6	17	1.9		
1,300	9	14.3	10	5.3	12	1.3	1	.6
1,400	11	17.5	22	11.8	13	1.5		
1,500	6	9.5	59	31.5	113	12.7	2	1.3
1,600	5	7.9	29	15.5	89	10.0		
1,700	3	4.8	14	7.5	49	5.5		
1,800			21	11.2	122	13.7		
1,900			1	.5	39	4.4	2	1.3
2,000			8		200	22.5	20	12.5
2,100			1	.5	13	1.5	2	1.3
2,200					37	4.2	17	10.6
2,300					30	3.4	4	2.5
2,400					32	3.6	5	3.1
2,500			1	.5	65	7.3	29	18.1
2,600			1	.5	6	.7	10	6.3
2,700					9	1.0	2	1.3
2,800					8	.9	1	.6
2,900					2	.2	1	.6
3,000					25	2.8	38	23.8
3,100								
3,200							1	.6
3,300							3	1.9
3,400								
3,500						.1	12	7.5
3,600							1	.6
3,700								
3,800							1	.6
3,900								
4,000							7	4.4
4,400							1	.6
Number of individuals	63		187		890		160	
Average salary	$1,300		$1,544		$1,924		$2,648	
Median salary	$1,300		$1,500		$1,900		$2,500	

[6] Including the colleges in groups 1 to 4. See note on page 849.

[7] Including the colleges in groups 5 to 7. See note on page 849.

[8] Including the colleges in groups 8 to 15. See note on page 849.

TABLE III

THE SALARIES OF FULL PROFESSORS IN 1912–13

Frequencies of Each Salary Amount in Specified Groups of Institutions

Annual Salary	In Carleton, Franklin, and Ripon	In Bates, Clarkson, Drury, Grinnell, Lawrence, and Mount Holyoke	In Drake, Newcomb, Beloit, Center of Ky., Dickinson, Hobart, Marietta, and Wabash	In Hamilton, Oberlin, Pittsburgh, Tufts, Washington and Jefferson, Middlebury, Rochester, Vermont, and Wellesley	In Bowdoin, Clark College, Indiana, Purdue, Swarthmore, Trinity (Conn.), and Union	In Dartmouth, Missouri, Worcester Polytechnic, Lehigh, Minnesota, Tulane, Washington (Mo.), and Western Reserve	In Cincinnati, Vassar, Amherst, Virginia, Williams, Cornell, Michigan, Wisconsin, Case, Rensselaer, and Stevens	In California, Massachusetts Technology, and Toronto	In Johns Hopkins, Stanford, Princeton, and Yale	In Columbia and Harvard	Frequencies in All Institutions Combined, Scaled by Steps of $500		
												Gross	Percentile
$800			1										
900											$750		
1,000			1								to 1,249	12	.8
1,100													
1,200	8	1	1										
1,300	1	2		1									
1,400	7	3	2	1							1,250		
1,500	2	12	13	4	5						to 1,749	147	9.3
1,600	2	16	1	5	2	2							
1,700	1	28	35	2									
1,800	3	5	21	14	4	3		1					
1,900			6	4							1,750		
2,000	2	5	2	64	16	10	2	1	3		to 2,249	227	14.3
2,100				9	7	1			1				
2,200			2	24	1	15		1					
2,300			1	4	13	10	3	2	1				
2,400			2	4	13	19	1				2,250		
2,500		1	3	21	42	11	44	6	12	4	to 2,749	266	16.8
2,600				2	1	10	1	1		under			
2,700			3		12	10	7	2	2	3,000			
2,800				4	12	11	6	1					
2,900						19	7				2,750		
3,000			1	6	5	25	77	18	38	3	to 3,249	286	18.1
3,100				1	1	10							
3,200					1	4	33		1				
3,300			1			4	24	7	2				
3,400					2	2			3		3,250		
3,500					1	5	67	8	25	8	to 3,749	205	13.0
3,600				1		18	4	16	2	3			
3,700						2							
3,800							6	1	2	1			
3,900							2		2		3,750		
4,000					1	8	32	37	63	35	to 4,249	194	12.3
4,100						1	2						
4,200									1				
4,300							1	1					
4,400						1			1	2	4,250		
4,500						1	7	3	22	27	to 4,749	67	4.2
4,600										1			
4,700													
4,800													
4,900											4,750		
5,000						5	3	8	34	44	to 5,249	95	6.0
5,100													
5,200										1			
5,300										1			
5,400										1	5,250		
5,500									3	34	to 5,749	40	2.5
5,600													
5,700										1	5,750		
5,800											to 6,249		
5,900													
6,000							3		1	21		25	1.6
Over 6,000									1	17	Over 6,250	18	1.1
											1,582 individuals Median salary $3,000		

salary, there would be a fairly pronounced influence of this sort.

We may say roughly that the teachers in intermediate grades in the smaller institutions are financially in a class with the instructors in institutions like Columbia, Harvard, Yale, Hopkins, Stanford, California and Princeton. How often they are, like these latter, young men proving their worth, and how often they are mature men whose achievements have not been such as to put them ahead financially, is a question to be settled only by proper measurements of the correlation of age with salary. The teachers in intermediate grades of institutions like Oberlin College get from $1,200 to $1,800, and represent gifted young men, somewhat older men waiting for fairly assured promotion, and still older men who have nearly or quite reached their salary limit as college teachers. The 890 teachers in intermediate grades in institutions like Dartmouth College or the University of Minnesota represent the group of assistant professors whose status has been studied by Professor Guido Marx, plus a financially superior group of junior professors and associate professors in large institutions.

In the case of the full professors, we have in Table III. the story of the salaries of mature men and women, accepted as teachers of the highest rank, in sixty-one institutions. This fairly represents the status of the full professor in the hundred and fifty better higher institutions of America.

There is a certain significance in the combined facts for the salaries of all these full-time teachers of accepted standing in the higher schools of America, which are shown in Table IV., although in this table all ages and all of the institutions are mixed. The significance lies in the possibility of easy comparison with similar facts for other professions or branches of civil service, and of easy contrast with salaries in industrial and commercial organizations. One such comparison with the salaries of men teachers in public high schools of the United States is made in the table itself.

TABLE IV

THE DISTRIBUTION OF THE SALARIES 1912–13

Of the 4,262 Instructors, Assistant Professors, Associate Professors and Professors in the 61 Institutions Combined

Salary	Frequency			Totals	Totals Expressed in Percentages	Similar Percentages for Male Teachers in Public High Schools in 1908 (approximate)
	Instructors	Teachers of Intermediate Grades.	Full Professors			
Under $750	51			51	*1.2*	*30.5*
$750 to 1,249	911	74	12	997	*23.4*	*44.3*
1,250 to 1,749	386	447	147	980	*23.0*	*13.0*
1,750 to 2,249	29	483	227	739	*17.3*	*7.1*
2,250 to 2,749	3	194	266	463	*10.9*	*3.1*
2,750 to 3,249		76	286	362	*8.5*	*1.6*
3,250 to 3,749		17	205	222	*5.2*	*.5*
3,750 to 4,249		9	194	203	*4.8*	
4,250 to 4,749			67	67	*1.6*	
4,750 to 5,249			95	95	*2.2*	
5,250 to 5,749			40	40	*.9*	
5,750 to 6,249			25	25	*.6*	
Over 6,250			18	18	*.4*	
Number of individuals.....	1,380	1,300	1,582	4,262		

THE RELATION OF SALARY TO AGE

An adequate treatment of the relation of salary to age requires the fiscal history of individual teachers. To infer the changes in salary due to age from the differences found between the salaries of groups classified by age is unsafe, since those who abandoned college training for other occupations at any age are very likely to differ as to salary from those who remain, and since we can not assume that the ability of those entering college teaching has remained constant during the forty years past. The foundation hopes to give the topic such adequate treatment in the future. The present section reports only measures of the variation of salary at the same age for certain groups—a limited and not exactly representative selection from college teachers of 251 men, all teachers of mathematics or the natural sciences in certain universities, who had been active enough in science by the year 1910 to be included in the second edition of Professor Cattell's "American Men of Science." The choice of these was dictated by practical exigencies and the results must not be taken strictly at their face value, although the use made of the facts has been kept free from fallacies due to the nature of the selection of these individuals. The selection is such as to exclude men of all ages of slight scientific achievement and to exclude somewhat more strictly the youngest. Also, as stated, it is a selection of men from, on the whole, a superior group of institutions.

In general, we have a fairly steady rise in salaries from the group of age 34 with a median salary of $1,800, through age 36 at $2,000, age 38 at $2,200, age 40 at $2,500, age 42 at $2,200, age 45 at $2,850, to $3,200 at age 49, and $3,300 at age 53. For the reasons stated, this result should be used with caution. What is certain is that the effect of age within these limits is real, large and more persistent to later ages than probably would have been assumed *a priori*.

There is an interesting difference in salary and in the relation of age to salary between the men who were rated in Professor Cattell's list of the 1,000 most esteemed as scientific workers and those who were less distinguished. In salary the more distinguished group have an advantage of about $800 at ages 36 and 38, about $1,000 at ages 40 and 42, about $1,500 at ages 44 and 46, and a still greater advantage at later ages. The median salary for the distinguished group rises from about $3,000 at ages 36, 38, 40 and 42, to $3,500 at ages 44 to 46, $4,000 at ages 48, 50, 52 and 54, and $5,000 at higher ages; while the median salary for the others remains at approximately $2,000 through ages 36 to 46, and is only $2,500 and $2,650 in the case of ages 48 to 54 and 56 and over. These figures are from too few cases to be used as precise measures of the differences in question, but are adequate to prove that ability as estimated by one's fellow scientists receives very substantial recognition in salary, and that, as in other professions and in industry and commerce, the less gifted men reach their maximum salary much earlier than the more gifted.

The variation in salaries for the same age is, as students who have made the matter a subject of careful observation and thought would expect, very wide. Men not over two years apart in age differ in respect to salary to such an extent that the highest salary is about four times the lowest. The intervening salaries are spread fully over the scale. Men receiving $2,000 may be from under 30 to over 60 years old, and men can be found with that salary at every intervening age. The effect of more

complete and more exactly representative data would be to increase the range of variation. This variation, it may be added, is a sign of healthy adaptation to the wide differences in energy, scholarship and devotion which must be expected even within such a picked group of men as college teachers.

THE APPRENTICESHIP SYSTEM IN AMERICAN HIGHER INSTITUTIONS

The higher institutions of America maintain an elaborate system of apprenticeship by their provision, fiscal and otherwise, for assistants, readers, teaching fellows and the like, who do educational work under more or less close supervision, generally as part-time workers who are studying for a degree, or who have just completed such study and are maintaining financial independence while waiting for engagement as full-time teachers.

The extent of this apprentice work in the larger institutions may be estimated from the fact that in Columbia, Harvard, Chicago, Michigan, Yale and Cornell there are reported 761 individuals with the title of assistant, more than the number of full-time professors in these same institutions. Some few of these are full-time teachers or scientific workers of experience,[9] but there are, to much more than counterbalance these, teaching fellows and young men with the title of instructor who are really apprentices.

The system is by no means confined to the large universities. Taking at random ten institutions of moderate size (Vassar, Indiana, Purdue, Oberlin, Cincinnati, Armour Institute, Virginia, Washington, Western Reserve and Brown), we find reported 237 assistants to 321 full professors. Moreover, there probably are other student assistants unreported because receiving only free tuition.

Even in the small institutions, much of the educational work is done by, and much practical training in college teaching is given to, such apprentices. Again taking ten colleges at random (Lafayette, Bowdoin, Colorado College, Dickinson, Adelphi, University of South Carolina, Goucher, Trinity (Connecticut), Beloit and Washington and Jefferson), we find reported 72 assistants to 157 full professors. Fifty-two of these were reported from a single institution, but, on the other hand, the student-assistants who were given tuition or tuition plus a hundred dollars or so were probably very often left unreported by other institutions in this group.

The fiscal status of these apprentices will not be described here, since any tables of salaries or changes in salaries for them are likely to be misleading unless worked out and presented in connection with fairly exact descriptions of the services which they perform and the training which they receive. These services range from the actual conduct of class-room and laboratory instruction to the mere correction of minor written exercises, or even to work as errand boys, keeping class-rolls, answering the telephone and fetching apparatus. In time required they vary so much that an assistant's pay probably would show a range of from fifty cents per hour to five times as much. The training ranges from such sympathetic guidance as a son might receive in a model father's office to the mere orders and criticisms that an ordinary office boy gets.

It is probable that four out of five of the men and women now entering college and university teaching hold such positions as paid assistants for a year or more. Consequently the organization and remuneration

[9] In departments of agriculture especially, subordinate scientific workers with salaries of from $800 to $1,500 are often given the title of "assistant."

of the work attached to assistantships offers important problems to the scientific student of administration. At its best an assistantship means self-support while advancing in knowledge and professional training for the assistant, equally good instruction for the classes in question, relief for the professor who can devote himself to work that he prefers, though it is in the popular sense much harder to do, and economy for the fiscal authorities who are enabled to pay certain services no more than efficiency requires.

THE CHANGE IN THE SALARIES OF TEACHERS IN HIGHER INSTITUTIONS

The salaries of instructors have shown a clear increase during the past five years. There has been an average gain of $80. This gain has been caused by a decrease in the proportions of salaries of $1,000 and under and an increase in the proportions of salaries of $1,050 and over. The increase has been greatest in the groups of institutions paying on the average under $1,000 in 1907–08. The gain for these averages $118, and their median salary has moved up from $900 to $1,000. The gain has been least in the institution groups which had the highest salaries in 1907–08, except Harvard and Columbia, being $63 for the combined group including California, Massachusetts Institute of Technology, Toronto, Johns Hopkins, Stanford, Princeton, Yale, Harvard and Columbia, and much less if Harvard and Columbia are excluded.

Table V. gives the percentage of instructors receiving less than $650, the percentage receiving from $650 to $849, the percentage receiving from $850 to $1,049, and so on, both for 1907–08 and for 1912–13. It will be seen that all the low salaries have decreased in relative frequency, while all the high salaries have increased.

TABLE V

CHANGE IN INSTRUCTORS' SALARIES

All Institutions Combined; Coarse Grouping

Salary	Percentile Frequencies		Differences
	1907–08	1912–13	
Under $650	2.6	1.4	− 1.2
$650– 849	13.0	9.9	− 3.1
850–1,049	42.6	31.7	−10.9
1,050–1,249	23.6	26.8	+ 3.2
1,250–1,449	10.8	18.6	+ 7.8
1,450–1,649	6.2	8.7	+ 2.5
1,650–1,849	.7	1.4	+ .7
1,850–2,049	.5	1.2	+ .7
2,050–2,249		.1	+ .1
2,250–2,449		.1	+ .1
2,450–2,649	.1	.1	0

The change in the salaries paid to teachers of intermediate grades is complex and difficult to express. In the institutions paying in 1907–08 in most cases from $1,000 to $1,500, clustered around an average of about $1,200, there has been an average gain of about $200. This gain concerns positions filled by 110 individuals in 1907–08, and by 161 in 1912–13. In Harvard and Columbia, at the other salary extreme, there has been an average gain of $226. Here 116 and 160 positions were concerned in 1907–08 and 1912–13, respectively. The remaining institutions, with 660 positions for 1907–08 and 979 for 1912–13, show an average gain of about $120, the gain being closely the same whether an average of $1,500, $1,600, $1,700, $1,800 or $2,000 was paid in 1907–08. The intermediate grades have then made most improvement in the institutions which in 1907–08 paid the very low or the very high salaries.

The general change is shown in Table VI. which gives the percentages (in 1907–08 and in 1912–13) of teachers receiving each salary amount. The grouping shows with special clearness the decrease in relative frequency of salaries below $1,500 and the increased relative frequency of salaries above $1,850. The change has been

an advance all along the line, not the mere bringing of very low salaries up to a higher standard, nor the addition of certain high-priced positions.

TABLE VI

THE CHANGE IN SALARIES OF TEACHERS OF INTERMEDIATE GRADES FROM 1907–08 TO 1912–13

All Institutions Combined; Coarser Grouping

Salary	Percentile Frequencies		Differences
	1907–08	1912–13	
Under $950	.4	.1	− .3
$950–1,249	11.6	4.8	−6.8
1,250–1,549	23.7	19.8	−3.9
1,550–1,849	25.9	25.7	− .2
1,850–2,149	20.1	22.0	+1.9
2,150–2,449	6.1	9.6	+3.5
2,450–2,749	8.2	9.5	+1.3
2,750–3,049	2.6	5.8	+3.2
3,050–3,349	.4	.3	− .1
3,350–3,649	.2	1.1	− .9
3,650–3,949	.1	.1	0
3,950–4,249	.4	.6	+ .2
Number of individuals....	946	1,300	

The salaries of full professors in these institutions have been increased on the average by about $225, the increase being about the same for institution groups paying salaries, in 1907–08, of $1,200, $1,400, $1,600, $1,800, $2,200, $2,700 or $3,000. The institution groups paying average salaries (in 1907–08) of $3,500 and $3,750 show smaller gains, about $125; Columbia and Harvard show larger, about $350. The low-salaried institutions have thus increased their professors' salaries by a percentage far greater than that of the high-salaried institutions. The general change is shown in Table VII. which gives the relative frequencies of each salary amount in steps of $500 in 1907–08 and 1912–13 for all of the institutions combined. The decrease in the lower salaries is clearly shown, the professorial staff having been moved up by about $200 all along the salary scale.

TABLE VII

THE CHANGE IN SALARIES OF FULL PROFESSORS FROM 1907–08 TO 1912–13

All Institutions Combined; Coarse Grouping

Salary	Percentile Frequencies		Differences
	1907–08	1912–13	
$750–1,249	2.9	.8	−2.1
1,250–1,749	12.3	9.4	−2.9
1,750–2,249	16.2	14.5	−1.7
2,250–2,749	15.3	17.1	+1.8
2,750–3,249	19.9	17.6	−2.3
3,250–3,749	9.9	12.6	+2.7
3,750–4,249	12.6	12.3	− .3
4,250–4,749	2.8	4.3	+1.5
4,750–5,249	4.4	6.1	+1.7
5,250–5,749	2.1	2.6	+ .5
5,750–6,249	.5	1.6	+1.1
Over 6,250	1.0	1.2	+ .2

From the results of this new examination of the financial status of college teachers, it will be seen that the situation, as compared with that of five years ago, is encouraging. In spite of a variability of salaries in the same institutions and of a financial overlapping of academic grades, there is coming to be a kind of general agreement upon a salary for a college instructor that is rather better than that of the man who teaches in a high school. Junior professors in the smaller colleges receive salaries almost equal to those of instructors in the large universities. Of 1,500 representative full professors one fourth receive $2,250 or less, one fourth $3,750 or more, and one tenth $5,000 or more, the median salary of all being $3,000. All salaries have increased during the last five years—those of instructors have risen by about $80, those of junior professors show a gain of from $120 to $226, those of full professors show an increase of from $125 in the smaller institutions to $350 in the largest. Teachers who by general agreement are considered distinguished receive from $800 to $2,400 more than their colleagues of the same age.

SOIL EROSION AND ITS REMEDY BY TERRACING AND TREE PLANTING[1]

PEOPLES have the habit of visiting their heaviest penalty—death—upon those offenders who imperil the life of the community. For example, horse-stealing among cowboys, destroying bridges among the Caucasus mountaineers. By the same reasoning the time is approaching when the permitting of gullying and soil erosion will rise in our minds from waste to offense and finally to crime.

Soil erosion is an irreparable waste, perhaps the only irreparable waste, when in an age of science one considers the great possibility of substituting one substance or commodity for another. Once the soil is gone, it is gone, and can not be returned. In locations of shallow soils underlaid with rock, a very small amount of erosion throws land out of agricultural use for a geologic epoch.

Owing to our vast resources and cheap land and the scientific nature of erosion control, little has thus far been done to check erosion either prohibitively or constructively. Another reason why we have done or appreciated so little in this field is that the problem is relatively new to the Teutonic peoples.

I. FACTORS TENDING TO AGGRAVATE AND INCREASE SOIL EROSION IN AMERICAN AGRICULTURE

1. *Relation of Agricultural to Nature's Erosion Control.*—Nature controls erosion with plant roots, so that in most of the United States the problem scarcely existed before white men's agriculture began here. The beginning of agriculture here was not merely the introduction of an old-established method. American agriculture is unlike that of Europe and far more deadly as a promoter of erosion. European agriculture has but little bare ground, most of the crops covering the entire surface of the ground and holding it with a root mass, as does wheat, barley, clover. America has added to the European agriculture the three great bare-ground crops of corn, cotton and tobacco. The tillage of these crops prepares the ground for erosion. The soil is kept bare, loose and soft. Frequent cultivations gash it ready for the starting of the digging rills of running water when a storm comes.

2. *The New and Erosive Type of Rainfall.*—Another factor, new to the Caucasian race, is a heavy summer rain which exists in all the territories growing these three crops, and comes in the peculiarly destructive form of a thunder shower, with its tremendous powers of eroding loose bare soil.

3. *The Increasing Area of Erosion-inducing Crops.*—The increasing demand for these bare-ground crops tends more and more to make us cultivate and destroy hilly lands which, while in good pasture or forests, erode but little.

II. FACTORS IN EROSION CONTROL

1. Deep plowing has been extensively recommended by our agricultural authorities, but casual observance of hill lands almost anywhere shows it to be but a partial remedy, and corn and cotton fields under the best recommended deep plowing can often be shown to be eroding at rates that are completely ruinous if kept up for any long period.

2. Contour plowing tends to diminish erosion, but this device is hostile to the American system of farming that is characterized by the utilization of machinery sweeping in straight lines over large areas.

3. Terracing has been quite widely used in the south, but usually in a relatively inefficient way because in effect it chops a field up into a multitude of small fields of irregular shape. Between these little patches are untilled banks that grow weeds instead of crops. We have, however, the recent discovery of the Mangum terrace worked out by a farmer at Wake

[1] Section I., of the A. H. A. S., has a committee on soil erosion. This committee appointed J. Russell Smith, Ph.D., professor of industry in the Wharton School of Finance and Commerce, University of Pennsylvania, a subcommittee to gather information as to the relation of tree crops to the erosion problem. This paper presented at the 1913 meeting of the section is the result of journeys of investigation in the Mediterranean countries and islands and in central and southern United States.

Forest, N. C., and now adopted by the Federal Department of Agriculture. It is a great improvement over any terracing to be found in either Europe or America. It consists of wide gentle ridges plowed up along the face of the slope so that the water flows slowly and harmlessly along it, while its wide gentle slope permits the planting of crops and the utilization of agricultural machinery directly across it at the same time that it controls the runaway waters. There is almost no washing of earth where the system is maintained, and the ground is fully utilized in the American way.

A proper appreciation of the economic and far-reaching importance of soil saving should bring us in a short time to a point where, by compulsion or premium, all tilled lands liable to washing would be handled by this method or some other equally efficient one.

4. Plowless utilization of land offers great possibilities for the checking of erosion and the vast increase of our crop area.

(*a*) *Forestry and Pasture.*—Thus far tree planting in the form of forestry has been almost the sole panacea, other than pasture, for steep lands. The fruitlessness and slowness of a forest, which yields its one crop in from twenty to one hundred and fifty years, is a profound objection to it as a resource for the owner of the average small farm. The yield of hill pastures is too small to be a satisfactory dependence. Therefore, we have plowed, gullied and destroyed.

The inefficiency of pasture is indicated by its almost entire elimination in the arable areas of western Europe where it has given away to tilled crops. Its inefficiency in comparison to tree crops is shown by the fact that the pounds of food, the income and the nutrition produced by an acre of good sheep pasture in England are less than that produced by a good walnut tree in France.

(*b*) *Crop Trees.*—The tree is nature's real engine of production. This scientific fact seems to have been overlooked, despite the great value that trees have been to us. By a spasmodic and chance development, the tree has given us a number of valuable tree crops. The land that is in harvest-yielding trees is usually the heaviest yielding and most valuable land. Witness the orchards everywhere. The king of all crops, as measured by the greatest amount of food produced and the value of the land, is a tree crop—the date.

Past development of tree crops has come peculiarly by chance. Now that we know how to breed plants, we need the systematic examination of all the trees of the country with regard to their present or potential crop possibilities. This is a task requiring much work and having tremendous promise of increased national wealth. This conclusion is borne out by the facts now known concerning American trees, and by the occasional development of tree agriculture both in this country and in Europe.

In this country while we have an extensive fruit industry, it has touched but a small corner of the possible tree-crop field, and the crops have been limited chiefly to those fruits that may be classed as succulents rather than nutrients, and they have been limited also to human food rather than to forage. Forage is the great demand upon the American farm. The animals eat several times as much as we do.

1. *Tree Forage.*—Forage tree crops in Europe, Africa and Hawaii, are suggestive of great developments in America. The carob bean, worth about one cent per pound at the farm, is a much prized nitrogenous and also carbohydrate stock food widely grown from Gibraltar to Palestine, and exported to England and to some extent to the United States. In Hawaii we have its counterpart, the mesquite bean, a bran and cornmeal substitute, rapidly becoming an important industry. The yields reported by the Hawaiian Experiment Station are almost staggering in their significance. Mesquite forests on rough untilled and untillable land are producing from 4 to 10 tons of beans per acre and the bean meal sells at $25 a ton. We have in the United States, waiting to be developed, similar leguminous, cropping trees growing from the Pacific to the Atlantic in the form of the mesquite in the west and the honey locust in the east, both great bean-yielding trees.

The European utilization of the acorn as swine food amounts to millions of dollars annually, and while we have some hundreds of thousands of hogs using the bought privilege of eating the acorns of our national forests, no one seems to have seriously considered the possibility of investigating the American oak as a corn substitute, yet there is good reason to believe it may be more effective than corn in many localities. American trees yielding several hundred pounds of acorns are common.

The utilization of the fig in Majorca and Portugal gives us added reason to contemplate the great possible service of mulberries and persimmons as automatic pig feeders, the crop being harvested by the animals themselves. The extensive use of the chestnut as a corn forage substitute in the mountainous parts of Italy, Corsica and France shows us what we might do in Appalachia with native or imported chestnuts, and also with hickories and other native nut trees.

2. *Major Foods from Tree Crops.*—The great dietary wants of man are proteid for tissue, carbohydrate and fat for energy. None of these wants has been met to any important extent by a tree crop in the United States. The proteid demand is substantially met in Europe by the use of the walnut, almond and filbert. Unquestionably the native and Persian walnuts of the United States, along with that remarkable tree, the pecan, and the numerous native hickories and hazelnuts, offer us great possibilities of new and extended industries and new staple food supplies.

The carbohydrate tree crops of the Old World are even more important than the proteids. The date (more nutritious than bread) is the main stay of vast areas, and the fig (even more nutritious than the date) is also a great food. The chestnut is, to large areas of Spain, France, the Mediterranean islands, and Italy, the same thing that corn is to the Appalachian mountaineers—a great starch food. The acorn, with an analysis much like that of wheat, excepting a shortage of protein, has for ages been a food for many Mediterranean peoples, and holds out at any time the possibility of being made into a very acceptable farinaceous food for the American people if they should choose to develop it, in an age of science and factory-prepared foods. Fat is furnished in Europe by the olive to so great an extent that the olive covers a larger proportion of Spain than wheat does in the United States. We have not yet developed an oil industry, although the resources are at hand.

3. *Areas and Adjustment.*—The tree is plainly our best means of utilizing steep and rough land, and if we can develop means of utilizing the cropping tree without the plow, we can easily double the crop area of the United States. At the present time tree crops cover only about one fiftieth of our agricultural area, when they apparently possess the possibility of covering half of it with great profit and with a permanence of production now unknown.

The example of a thousand per cent. increase in value of a Corsican hillside when well established in chestnut orchards that have never been plowed and which have produced for centuries, is exceedingly suggestive.

The problem is not merely a problem in forestry, for it is an established fact, that the fruiting trees must have sunshine on all sides. Numerous modifications of the forestry situation, however, suggest themselves. Tall trees like the pecan might be surrounded by coppices of leguminous trees like the locust, which might attain salable size, and by their nitrogenous roots greatly enrich the soil, as is the case where certain leguminous trees are grown with coffee. Crop trees like the pecan and walnut, persimmon or mulberry might be surrounded by thickets of bush size legumes, which absolutely maintain the soil against erosion, which enrich it, and which might be annually cut in the place of being annually plowed, or they might be pastured once a year with goats, and thus kept under control, made to render their service to the crop tree, and still give some value as forage.

4. *Moisture and Fertility Control.*—American agriculture is unquestionably suffering from too great a conviction that cultivation

is essential to the preservation of moisture and the supplying of fertility.

There is little doubt that the earth mulch, a preparation for erosion, does make the fertility more available, and does check evaporation. We need much more knowledge than we now have as to whether or not the same results may not be obtained by the application of mineral or other chemical fertilizers, which will increase natural vegetation, which will therefore increase humus, and the natural water-holding power of the soil. Rather convincing evidence as to the efficacy of this latter method is to be had in the sod mulch orchards under the care of the Ohio Agricultural Experiment Station, and also in the variation of crop yields in rich and poor lands in a dry season in the Berber villages of Northern Algeria. At the present moment the idea of the maintenance of fertility and a good crop yield without tillage is so unorthodox that almost no experiment stations in the United States will look at the subject with respect, yet in it lies great possibility of the extension of tree-crop agriculture to large areas of land where cultivation is difficult and is almost synonymous with erosion unless careful terracing shall be worked out.

The actual holding of water upon the ground until it sinks in is an aspect of the matter well worthy of extensive investigation. The mangum terrace, which is so efficient in taking water away from a hillside without erosion, can doubtless be enlarged and made absolutely horizontal so that it will keep the water where it falls, after the practise of Colonel Freeman Thorpe, of Hubert, Minnesota. This is a practise worthy of much experimentation, and one which fits peculiarly into the tree-crop idea. It is doubtless true that in many localities the water standing behind the horizontal mangum terrace would injure wheat, clover and other small crops. On the other hand, there seems to be little reason to anticipate that it would injure trees that stood upon the terrace and had their roots beneath the reservoir of water, which might stand and freeze for considerable periods with no injury to the tree, which would get the water when it soaked into the ground. This has been proved successful for 20 years in a Pennsylvania apple orchard.

This practise has been worked out for many decades in the olive orchards of Central Tunis around Sousse, and it unquestionably can be utilized with tree crops in many parts of the United States. Its limitations must be defined by experimentation, which may also find aids in the growth of deep-rooting annual plants to increase porosity and absorbing power of the soil.

There also appears to be no reason why this mangum terrace might not be modified into a series of basins that would hold near each tree the water that fell near it, and thus practically apply the methods of the California water economizing irrigators. Such preparation of the soil would be effective for many years and would therefore be less expensive than annual cultivation.

An effect of this holding of water where it fell would be the absolute stoppage of a loss of fertility that results from the washing away of incrustations of soluble salts deposited through the evaporation of earth moisture at the surface. The effectiveness of this process in bringing earth salts to the surface is well known. It has given us our alkali soils, but we owe it to Colonel Freeman Thorpe to call our attention to its surprising effectiveness as an agency in fertility loss where water is allowed to run off of the surface. This factor alone may be found worthy of all the effort necessary to hold water where it falls.

III. CONCLUSION

If the economic botanists and plant breeders can give us a series of new cropping trees which will furnish new foods for both man and beast, we will have an economic factor which will combine a number of forces, because it helps to meet a number of needs. It will greatly stimulate food production, also wood production. Through the development of the plowless agriculture and terrace water holding, we will have conservation of the soil and of fertility. We will also have in this combination the greatest of all forces yet

brought to bear upon the problem of flood control, and also a great aid to navigation and irrigation, because of the better conservation of water in the soil for springs and streams.

It is a problem with which the individual farmer of an intellectual turn of mind can experiment in a small way, but above all it is one which needs, even demands, the attention of the federal government and many of the agricultural experiment stations.

J. Russell Smith
University of Pennsylvania

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND THE STATE

In an address at the annual banquet of Technology alumni in January, Governor Walsh suggested a closer cooperation between the institute and the state. The result has been, in its successive steps, the appointment of a special committee to consider the matter by Jasper Whiting, president of the alumni association, a conference with the governor in March, an investigation of all the sources of information and a report to the alumni council on May 25. The latter while it has naturally been based on the institute and its resources proves to be so broad in its applications that there is place in the plan for all the institutions of the state that can give advice. "When they are so harnessed to the state's interest," the report reads, "they will constitute a great state university geographically diversified, possessing the momentum of valuable traditions, the strength of long years of experience and moral influence through their great alumni bodies—all this making of them units, which if assimilated by a wise state policy will form a coordinated system of educational facilities, which in its broadest sense is a university."

First there is recommended legislation which shall increase and regularize the services of members of the faculty of the institute (and other institutions, to be specified in the act) on state boards and commissions, either as members or in an advisory capacity. Such legislation should be applicable to all state commissions which conduct work requiring scientific or technical skill or advice. Suggestions for direct payment for such services direct to the institution are made, since it is best fitted to apportion such payments between individual service and the use of the laboratories of the school.

The second recommendation is that the use of the laboratories and shops of the institute be placed at the service of the state under appropriate conditions which will safeguard the educational purpose of the institute and the administrative needs of the state. No direct charge should be made for the use of these laboratories, but the state should bear the expenses of labor and material plus a fixed sum to be added to cover wear and depreciation. Provision should be made for an equitable adjustment of this charge.

For its third suggestion the committee advises the establishment of a bureau of technical information, which shall without charge furnish to the state and the public, advice which may be obtained without substantial expense, either in furnishing ordinary scientific information or indicating the lines of inquiry to be followed.

The committee recommends the appointment by the governor of a permanent committee on cooperation to carry into effect these recommendations, to study further the needs of the state as to closer cooperation between it and the institute and additional means of making such cooperation effective. Such a committee would also look forward to a system of cooperation between the state and the various other educational institutions.

The committee finds that from its inception the Massachusetts Institute of Technology was intended to serve the scientific needs of the state and its people. Its charter looks to aiding the advancement, development and practical application of science in connection with the arts, agriculture, manufacture and commerce. In this department of its activities the committee finds momental achievements to the credit of Tech in many different divisions of work. In fact the whole history of the institute shows that the institute has given to the state and that the state has drawn freely from

the institute. The state has availed itself of the faculty of technology and of the shops, laboratories and experiment stations and it has furnished problems for the student body. But all of this, the committee believes, has been in an incidental and casual way. There has been cooperation undefined, unguided and fragmentary. It has lacked the stimulus of continuity or organization, the spur of recognized state service. "The time has come," writes the committee, "to formulate the union, to make it official, to the end that the institute may be strengthened, in power and prestige, and that the state may derive in full the benefit at hand."

PRESERVATION OF THE NATIONAL MONUMENTS OF CHINA

PRESIDENT HENRY FAIRFIELD OSBORN of the American Museum of Natural History has addressed under date of May 14, 1914, to Secretary of State Bryan and to President Yuan Shih-k'ai of China, the following letters relative to the preservation of the art and historical monuments of China.

HONORABLE WILLIAM J. BRYAN,
Secretary of State,
Washington, D. C.

Sir: The Chinese race furnishes perhaps the greatest of all records of human society, and its future is closely associated with the destiny of society in this hemisphere. Our country contains an ever-increasing number of men and women devoted to the hope of China's triumph in modern civilization and government, in which case she will extend her matchless social and human experiment continuous from the remotest times unbroken. In this connection interested persons and institutions in the United States are seeking to establish in China a school of archeology as a means to encourage protection of the antiquities of China and provide for study there of China's ancient history.

On account of the ruthless destruction and plunder of antiquities in China since 1900, involving American citizens, the following individuals and organizations represented, having memorialized President Yuan Shih-k'ai as shown herewith, have the honor to request your aid in the official transmission of their memorial herewith enclosed, directly to Peking.

Furthermore, we have the honor to request:

First, That the Department of State, through its officials in China, use such means as it may determine to discourage all American citizens from vandalizing in China and from trafficking in broken and stolen sculptures and other archeological and art works of historical value belonging to the people of China, and to render aid with counsel wherever possible to shield Americans from being involved with plunderers of Chinese antiquities, and in all ways possible assist in preserving the good name of the United States, its citizens, agents and institutions, free from connection with the destruction of Chinese monuments and antiquities and the traffic in stolen and otherwise immorally or criminally obtained Chinese objects of antiquity.

Second, That the Department of State, officially, semi-officially or unofficially, as possible, through its officials in China and elsewhere, discourage the plunder and destruction of Chinese antiquities in times of peace or war in China, whenever opportunities permit, and support and encourage the Chinese officials and people in taking effective means to conserve their antiquities for China's benefit and the benefit of other nations.

Respectfully submitted,
(Signed) HENRY FAIRFIELD OSBORN,
President

PRESIDENT YUAN SHIH-K'AI.

Sir: We have learned with profound concern, that through various evils of modern origin, monuments and antiquities in China invaluable to present and future generations of Chinese and to the world, have been irreparably lost and destroyed; that the high material value put by Western civilization upon antiquities and products of art showing the progress of mankind, has lately resulted in the commercialization, plunder and destruction of antiquities in China beyond the power of ordinary influences to control; furthermore, that such plunder and destruction not only are despoiling China of some of the garments of her ancient civilization, but actually tend to break down Chinese society by depriving the Chinese people of their heritage, besides crippling research and education, and retarding progress;

Therefore, having a friendly interest in the good of China and the republic, and having in mind the interests of enlightenment of human welfare generally, as well as the responsibilities devolving upon the nations and upon all well-wishers and friends of China, we have the honor herein to memorialize your Excellency and respectfully and earnestly to urge as follows:

That in view of all the circumstances and conditions; in accordance with ample traditional practise and precedent established by China's ancient rulers; and in cooperation and harmony with the policy of the most advanced governments, the national government of China make new legal recognition of China's monuments and antiquities, and of all forms of national art of antiquarian and historical value as national property, and, in the manner adopted by other nations, newly take national possession of the same and bring them under national protection for preservation in China for the lasting benefit of the Chinese people and of mankind generally.

Respectfully submitted,

(Signed) Henry Fairfield Osborn,
President

THE BRITISH ASSOCIATION IN AUSTRALIA[1]

At the end of June and in the first week of July 400 members of the British Association for the Advancement of Science will leave England to meet for the annual sessions of the Association in the state capitals of Australia. The visit is made at the invitation of the Australian Commonwealth Government, whose guests the members of the association will be, and by whose generosity so protracted a journey is made possible.

Such a meeting is memorable in many ways. It adds completeness to that system of exchange of scientific thought and scientific men between the United Kingdom and the Dominions over-seas which has been steadily growing since the beginning of the century; and it will serve to link still more closely the newer universities with the older throughout the whole of the Empire. The previous visits of the British Association to Canada and to South Africa gave fresh impetus to scientific work, and were followed by tangible results in the creation of new scientific institutions and laboratories. There is assurance beforehand that this precedent will be repeated in Australia, for one of the objects of the visit is to afford opportunities for joint discussion on cooperation in research between the southern continent and the countries of the Northern Hemisphere in astronomical, meteorological and anthropological problems.

There are advantages of a reciprocal kind to those who would not otherwise sacrifice four months of the scientist's year in a visit to Australia. Problems await attack in solar physics and in the distribution of the stars; problems in the evolution of segregated species of animals and plants; of physiological adaptation; of atmospheric electricity and earth magnetism; of the antiquity of races and of the development of social conditions—in short, problems affecting every department of science, which can only be carried to completion with the aid of data obtained in the Southern Hemisphere and the southernmost continent.

The commonwealth government, the state universities and the Australian people are making every provision that the fullest opportunity shall be given to the meeting to investigate both the work that is being done and that which has to be done in the fields of zoology, botany, physiology and engineering. It should be added as not the least remarkable of the circumstances of this meeting that this is the first time that any government has set aside so large a subsidy for the purposes of the encouragement of science.

The members of the association proceed in two parties. The advance party of 70, in which the president-elect, Professor William Bateson, F.R.S., travels, and which takes with it a number of zoologists, botanists and geologists, will go by way of the Cape to Perth, in Western Australia. This party stays a week, making excursions for field work in the sand plains, in the Darling Range, the Irwin River district, the coast or the Kalgoorlie goldfield during the larger part of it; and, at most, three evening lectures will be delivered, one of them by Professor Herdman on "Life of the Sea," and another by Professor A. S. Eddington on "The Stars and their Movements." This visit is an unofficial part of the meeting; but since among those who take part in it are Professor F. W. Dyson (the astronomer royal), Professor H. E. Armstrong, Professor Poulton, Professor Dendy and Professor W. J. Pope (presidents respectively of the

[1] From the London *Times*.

zoological and chemical sections), Professor A. D. Waller, Sir John Biles, Dr. A. C. Haddon and Mr. A. D. Hall (president of the agricultural section) it is very strongly representative of the main body.

The rest of the party, the main body, will pick up the advance party at Perth about August 7 and will sail with them for Adelaide. If it had not been for the death of Sir W. H. White, who was to have been president at Birmingham last year, Sir Oliver Lodge would have been the president for the Australian meeting; and Australia has been eager to welcome him in his presidential capacity. Consequently he has been asked to deliver an address, and has consented. At Adelaide he will speak at an evening meeting on "The Ether of Space," and this valedictory discourse will embody his conclusions as to the objective reality of this concept, and his criticisms of the new mechanics by which an attempt is being made to replace it. Dr. W. J. Sollas, of Oxford, will deliver the other evening discourse on "Ancient Races and Their Modern Representatives"—of whom he believes the extinct Tasmanians to have been the most primitive—and Sir Charles Lucas and Mr. A. D. Hall will address their sections of geography and of agriculture.

From Adelaide, after a stay of four days, the association will go on to Melbourne, which with Sydney will be the auditorium of the larger part of the addresses, papers and discussions. Following the precedent of South Africa, the presidential address of Professor Bateson will be divided into two parts. The address in Melbourne will discuss the problem of evolution in the light of Mendelian discoveries. Professor Bateson will especially attempt a consideration of the nature of variation, showing the extreme difficulty of any longer maintaining the received doctrines on these subjects. At Sydney he will proceed further to show the application of the results of Mendelian analysis to man, pleading for simpler views of life and death and for a fuller recognition of biological knowledge in regard to conduct and the ordering of social structures.

The president's address will be delivered on the evening of August 14, and on that morning and on two other days the sections of mathematics, chemistry, zoology, economics and physiology will meet. When the association is adjourned and meets again in Sydney (August 20) the second part of the presidential address will be delivered and the remaining sections of geology, engineering, anthropology, botany and education will assemble. In another week the members move on again to Brisbane, where the sections of physiology and agriculture reassemble and where an address will be delivered by Professor W. E. Brown on "Cosmical Physics." These addresses and evening lectures are a special characteristic of the meeting, and among those who deliver them will be Sir E. A. Schafer on "The Origin of Life," Sir E. Rutherford, Professor Elliot Smith, Professor N. E. Armstrong, Professor E. B. Poulton, Professor G. W. Howe, Professor H. H. Turner, Professor B. Moore and Dr. Rosenhain.

After leaving Sydney some of the members of the association will visit New Zealand, and others will go to Tasmania. After the concluding meeting at Brisbane some will return directly home, but a number, splitting into larger or smaller parties, will continue the program of excursions which are so liberally provided for in the program of the month's meeting. One party, for example, will travel across North Queensland, others will visit New Guinea, where the commonwealth government has placed a yacht at the disposal of a specific anthropological investigation; and there are many other excursions for those who have time to make them before returning home by way of New Guinea and Java.

SCIENTIFIC NOTES AND NEWS

WITH the close of the present term at the Massachusetts Institute of Technology, Professor Robert H. Richards will retire from the active work of teaching which he has followed for forty-six years. He is made professor emeritus and receives the benefits of the Carnegie Foundation. Professor Richards has

been identified with the institute since its beginning, he was a student in the first class and a graduate in the first group to receive the B.S., following which he became assistant—1868–1871—and then in 1871 took the chair of mineralogy, in the department that afterwards developed into that of mining engineering and metallurgy.

Professor John Perry has recently retired from the staff of the Imperial College of Science and Technology, and a fund is being raised for the purpose of giving expression to the appreciation of his services to the teaching of mathematics and to engineering education.

The astronomer royal, Mr. Frank Watson Dyson, has been elected Halley lecturer at the University of Oxford for next year.

Lord Lamington has accepted the office of president of the Research Defence Society, in the room of the late Sir David Gill.

The honorary degree of doctor of engineering has been conferred upon Commerzienrat Carl Paul Goerz, the head of the Goerz Optical Works, by the Technical High School in Charlottenburg.

Dr. Smith Ely Jelliffe, of New York City, has been elected a corresponding member of the Paris Neurological Society.

Professor George C. Whipple, of Harvard University, has been chosen as one of three American engineers to act with three Canadian engineers to advise with the International Joint Commission on matters pertaining to the pollution of the Great Lakes. Professor Whipple has also been chosen a member of a commission consisting of five sanitary engineers to advise the commissioner of health of New York State on matters pertaining to the location of tuberculosis hospitals on catchment areas used for public water supplies.

Dr. C. E. Mendenhall, professor of physics at the University of Wisconsin; Dr. Knight Dunlap, associate professor of psychology at the Johns Hopkins University and Dr. W. E. Burge, assistant professor and acting head of the department of physiology at the University of Illinois, have accepted invitations to carry on research work during the coming summer in Nela Research Laboratory (formerly known as Physical Laboratory, National Electric Lamp Association). Dr. Willibald Weniger, of the Oregon Agricultural College, has also been secured for special research work during the summer and Mr. A. F. Wagner, of Purdue University, has been appointed to a temporary assistantship in the laboratory for a part of the vacation period.

An exhibition of photographs by Mr. A. Radclyffe Dugmore, the African traveler and author of works on photographing big game in their native haunts, is being held at the house of the Royal Photographic Society, London.

Professor Marshall H. Saville, of Columbia University, has sailed for Colombia, to make archeological explorations there and in Equador.

Dr. J. N. Rose, research associate in the Carnegie Institution of Washington, left New York on June 10 for the west coast of South America, where he goes under the auspices of the Carnegie Institution of Washington and the New York Botanical Garden, for the purpose of making a special study of the Cacti of the deserts of Peru, Chile, Argentina and Bolivia. He expects to send large collections of living plants to the New York Botanical Garden. He will be absent from Washington between four and six months.

Professor Albert Johannsen, of the University of Chicago, has sailed for Europe to spend the summer in the mineralogical laboratories of Germany and Austria.

Sir Ernest Shackleton with nine members of his expedition have visited Norway to test provisions and motor-sledges for his forthcoming Antarctic expedition.

At Cornell University officers of Sigma Xi have been elected for the ensuing year as follows: *President,* Professor A. W. Browne, department of chemistry; *Vice-president,* Professor J. G. Needham, department of biology; *Counsellor,* Professor D. S. Kimball, Sibley College; *Recording Secretary,* Professor F. K. Richtmyer, department of physics; *Corre-*

sponding Secretary, Professor James McMahon, department of mathematics; *Treasurer,* Professor W. A. Riley, department of biology; *Program Committee,* Professor H. N. Ogden, civil engineering; Professor H. S. Jacoby, civil engineering; Professor A. W. Gilbert, department of plant breeding, and Professor A. W. Browne, *ex-officio.*

PROFESSOR W. M. DAVIS gave a lecture in the Town Hall at Suva, Fiji, on April 30, on "The Origin of the Coral Reefs of Fiji," in which he presented the chief results of his seven weeks' visit to those islands as a part of his Shaler Memorial study of coral reefs in the South Pacific. On May first he left for New Zealand.

ON May 25 Professor M. A. Rosanoff, of Clark University, presented before the research staff of the Mellon Institute, University of Pittsburgh, a theory of the mechanism of sugar inversion by acids.

DR. AMOS LAWRENCE MASON, senior physician of the Boston City Hospital and formerly associate professor of clinical medicine at the Harvard Medical School, has died at the age of seventy-two years.

THE death is announced of Miss Ida Freund, late lecturer in chemistry at Newnham College, Cambridge.

MR. WILLIAM WEST, lecturer at the Bradford Technical College, known for his contributions to botany, died on May 14, aged sixty-eight years.

Le Figaro for May 9 contains an announcement of the death of the noted French mathematician Jules Molk, who is especially well known to American mathematicians as the principal editor of the French edition of the large mathematical encyclopedia, which is now being published jointly by Gauthier-Villars of Paris and B. G. Teubner of Leipzig.

THE U. S. Civil Service Commission announces an examination for assistant biochemist in the U. S. Public Health Service, for duty in the field, at $2,000 a year, and for assistant mining engineer, in the Bureau of Mines, for service in the field, in relation to coal mining or metal mining, at salaries ranging from $1,800 to $2,400.

ON the afternoon of May 23, a conference was held at the Brooklyn Botanic Garden between the garden staff and the high school teachers of biology of Greater New York, as represented by the New York Association of Biology Teachers. The purpose of the conference was to offer an opportunity for the members of the association to become better acquainted with the aims, equipment and work of the garden, and to enable the latter to secure from the teachers practical suggestions as to how the garden may render the largest service to the teaching of botany in New York City and vicinity. The program was as follows:

What the garden can offer the schools.
  The director of the garden.
  The curator of public instruction.
  The instructor.
High school classes at the garden.
  The teachers of classes that have used the garden.
Suggestions from teachers.
  Open discussion led by the president of the New York Association of Biology Teachers.

Following the conference there was an inspection of the first section of the laboratory building and the first two sections of the conservatories. The second section of the conservatories devoted to tropical economic plants was opened to visitors for the first time on this occasion and will hereafter be open to the public daily.

THE Harpswell Laboratory will be open for its fifteenth season from June 21 to the middle of September. It is intended to offer to investigators an opportunity to study a more northern fauna and flora than any other station in the United States. Though the laboratory is small, it has a good equipment, sufficient for any ordinary investigations. Its location, at South Harpswell, Me., on the shore of Casco Bay, assures abundant material for various lines of biological investigation, as well as a most comfortable summer climate and fine natural scenery. During the past some seventy higher institutions of learning have

been represented by workers there and a considerable amount of material has been published, based wholly or in part of investigations carried on there. This year it will be under the control of Drs. Neal and Kingsley, who have carried it on for several years, and all inquiries concerning rooms and other accommodations should be directed to Dr. H. V. Neal, Tufts College, Mass., until June 17; after that date to him at South Harpswell, Me. The laboratory, at most, can accommodate but fifteen workers at a time, and already considerable part of its space is engaged for at least a part of the summer.

It is announced that the biological laboratory of the United States Bureau of Fisheries at Fairport, Iowa, will be opened for investigators on June 15, and is expected to remain in active operation until about September 1. Those desiring to have the use of tables and other facilities for investigation may communicate with the commissioner of fisheries, Washington, D. C., or with the director of the Fairport station, Fairport, Iowa. The station is well equipped with laboratory and collecting apparatus, as well as with ponds and tanks, and supplies of river water and filtered water.

Wilhelm Engelmann, of Leipzig and Berlin, announces the publication of the *Internationale Zeitschrift für physikalischechemische Biologie*. The editor is Dr. J. Traube, of Charlottenburg, with the assistance of Professor H. J. Hamburger, of Gröningen, Dr. V. Henri, of Paris, and Dr. J. Loeb, of the Rockefeller Institute for Medical Research, New York. The periodical will appear at irregular intervals, six parts forming a volume. It is hoped that about three volumes will be issued in the course of the year.

Dr. von Le Coq, the distinguished explorer, has promised, as we learn from the London *Times*, to lecture on his recent tour in Chinese Turkestan before the Royal Asiatic Society in the autumn. Writing from Berlin a few days ago he states that the results of his last journey have been very satisfactory, both in quality and quantity. His collections fill 152 cases. He worked mainly at Kucha and at Tumshug, near Maralbashi. At Maralbashi he found a number of true Gandhara sculptures, some being exact counterparts of sculptures in slate in existing collections. But the finds, instead of being carved from Himalayan slate, were moulded in clay and plaster, some of the moulds being found alongside. Many of the "sculptures" were still covered with paint and gold leaf. He also discovered manuscripts, the first, it is believed, ever found at Tumshug. Some of these were in Sanskrit, and others, perfectly preserved, in an Iranian language. Other finds were a small but fine cornice, decorated in pure Sassanian style, and a number of heads of Sassanian knights; some good bronzes and statuettes in wood.

The national forest reservation commission has approved the purchase of the Pisgah Forest from the estate of the late George W. Vanderbilt, at an average price of five dollars an acre. The tract consists of 86,700 acres and the total cost is therefore $433,500. The price paid is less than the average for other tracts already acquired, although the Pisgah Forest has been developed by its former owner into one of the best forest properties in the country. This is the second time that the commission has had the purchase of this tract under consideration. Once before, during Mr. Vanderbilt's lifetime, the question of its purchase was taken up, but the commission did not deem it advisable to purchase it at that time. The tract includes portions of Transylvania, Henderson, Buncombe and Hayward counties, in North Carolina. It covers the entire eastern slope and portions of the northern and western slopes of the Pisgah range, one of the most prominent of the southern Appalachians. Its forests influence for the most part tributaries of the French Broad River which unites with the Holstein River at Knoxville, Tennessee, to form the Tennessee River. In accordance with Mrs. Vanderbilt's desire, the national forest reservation commission will retain the name of "Pisgah Forest"; in fact, the general area, in which this forest is located and in which other purchases may be made, is already designated as the "Pisgah Area." It is proposed

also to make it a game refuge for the preservation of the fauna of the eastern mountains. It is particularly well suited to this purpose since it is already well stocked with game and fish, including deer, turkey and pheasant; and in the streams rainbow trout and brook trout, with which they have been systematically stocked from year to year. With this purchase, and with others just approved, the total area approved for purchase under the Weeks law in the eastern mountains is 1,077,000 acres.

FACTS regarding our forest resources, their value and their waste, are condensed in an eight-page illustrated circular of the American forestry association just issued. The lumber industry is said to employ 735,000 people, to whom are paid annually $367,000,000 in wages, the worth of products being $1,250,000,000. The forests of the country cover 550,000,000 acres. An average of 70 human lives are sacrificed annually in forest fires, says the circular, and a loss occurs of $25,000,000. Damage from insects and tree diseases, which follow fire, costs each year $50,000,000. The cost of destruction resulting from floods is not estimated, but is given as "countless millions." But the circular expresses hope more than pessimism. As well as the colored pictures showing the forest fire, the effects of the fire, and the damage caused by floods, it shows also forests planted and grown under intensive management, and the national forest ranger scouting for fires on the mountain lookout station. The effective patrol here referred to has reduced "forest fire losses to as low as one tenth of one cent an acre." It is pointed out that by planting forests an annual income could be derived in the country of $65,000,000; and by preservative treatment upon timber each year $100,000,000 could be saved.

THERE has recently been established in Nela Research Laboratory (formerly known as Physical Laboratory, National Electric Lamp Association) a section of applied science in addition to the section of pure science which was established over five years ago. The section of applied science will be separate and distinct from the section of pure science and will not restrict or in any way affect the established work in pure science. A research fellowship in ophthalmology in Nela Research Laboratory has been established for the year 1914–15. The fellowship carries with it an honorarium of $700 and is open to men sufficiently advanced in specialized medical training to carry on an independent investigation of some problem having to do with the effects of light and attendant radiation on the eye.

WE learn from *Nature* that the movement inaugurated a few months ago to develop as completely as possible the educational side of the kinematograph made definite headway on Wednesday, May 20, when the Educational Kinematograph Association was formed at a meeting in London. Among those who have joined the council of this body are Sir H. A. Miers, Rt. Hon. Sir Horace Plunkett, Dr. C. W. Kimmins, Professor R. A. Gregory, Professor J. W. Gregory, Mr. C. Bathurst, M.P., Dr. Lyttelton, Mr. A. P. Graves, Professor Darroch, Sir Edward Anwyl, Sir Harry R. Reichel, Sir Bertram Windle, Sir Albert Rollit and General Sir R. Baden Powell. At the meeting a report was presented by the secretary, Mr. Morley Dainow, on behalf of the provisional committee, suggesting that the work of the association should be to encourage the best types of kinematograph production and develop a completely educational plan for their use. The report was adopted, subject to revision by a subcommittee. The following officers were elected vice-presidents: Sir Wm. Chance, Dr. Kimmins, Colonel Sir J. R. D. Smith, Sir Albert Rollit. An executive committee representative of educational and social welfare associations was also appointed, and Mr. Morley was elected secretary.

UNIVERSITY AND EDUCATIONAL NEWS

MR. ANDREW CARNEGIE has added, presumably from the income of the Carnegie corporation, $2,000,000 to the endowment of the Carnegie Institute of Pittsburgh, to be equally divided between the institute and the school

of technology. Mr. Carnegie's gifts to these institutions now amount to $24,000,000.

By the will of former Judge John Forrest Dillon, Iowa State University receives $10,000 and Iowa College and Cornell College, $1,000 each.

An additional gift of $25,000 has been received by Oberlin College for carrying out the general building plans and the improvement of grounds.

The alumni of the University of Illinois are planning to erect a $150,000 building as a memorial to John Milton Gregory, first president of the university. It is to house an art collection gathered by Dr. Gregory and a new collection of figures and panels which the alumni association intends to buy.

The Arnold Biological Laboratory, ground for which has been broken at Brown University, is expected to be finished a year from this summer. The building itself will cost $80,000, while $30,000 more will be spent upon the equipment.

The Drapers' Company has made a grant of £200 a year for three years for anthropology at the University of Cambridge.

Last year Sir William James Thomas, of Ynyshir, undertook to build and present to the University College of South Wales and Monmouthshire on a site contiguous to the old buildings in Newport Road a complete physiological department, so constructed as to form a part of a scheme for a complete medical school on the same site. Now, as we learn from *Nature*, a donor, who wishes at present to remain anonymous, has offered to build the whole of the buildings necessary not only for a medical school, but also a school of preventive medicine, at an estimated cost of £60,000. One of the conditions attached to the latter gift, however, is that the funds supplied by the treasury should be sufficient for the upkeep of the complete school.

Central Turkey College at Aintab has received from the Turkish government official recognition as *école superieure*. It is the first of the American colleges in Turkey to secure such authorization for any part of its regular curriculum.

Mr. Albert L. Barrows has been appointed instructor in zoology in the University of California.

Dr. Thomas H. MacBride, professor of botany, has been appointed president of the Iowa State University by the State Board of Education.

DISCUSSION AND CORRESPONDENCE

THE ORGANIZATION OF A UNIVERSITY DEPARTMENT

To the Editor of Science: I have read with interest the letter of Professor F. L. Washburn on "Heads of Departments," in Science of May 1; and it has occurred to me that your readers might be interested in an account of the present organization of one of the largest departments in one of the largest universities in America.

At Columbia University a department of English was first established in 1899 by assigning to it the professor of English literature, the professor of dramatic literature and the professor of rhetoric and English composition; and these three thereupon organized by inviting the professor of English in Teachers College to join them and by electing the professor of English literature as chairman and the professor of rhetoric as secretary. On the death of the professor of English literature, the late Thomas R. Price, the position of chairman was abolished, the senior professor of the department being expected to preside at its meetings and all the administrative duties being confided to the secretary, who was relieved of a part of his teaching that he might be enabled to carry this extra burden.

With the expansion of Columbia University and of its several colleges and schools, Columbia College, Barnard, Teachers and the School of Journalism, the department of English has grown in numbers; and several years ago the department of comparative literature was merged with it, so that it now consists of more than twenty professors, assistant professors and associate professors. And during the past fifteen years it has administered its

own affairs in town-meeting, so to speak, as an absolute democracy, in which every member has an equal voice. It has made all nominations; it has recommended all promotions; and it has requested all increase of salary; and in every case its nominations and recommendations have been favorably received by the president and by the trustees, who have granted all our requests—excepting only those not at the moment financially advisable.

Almost every member of the department serves on one or more of the special committees, to whom we confide the oversight of our several activities. Whenever we have felt the need of developing instruction in any part of our field, we have never had to draft a man for service, for all have been ready to volunteer for duty. As a result of this harmony every part of our work—graduate and undergraduate, in college and in school, and in the extension courses—has been coordinated in response to our individual and united understanding of the demands of the occasion. And so complete is this harmony, that since the department was established, no action of any kind has been taken and no recommendation has been made, other than by a unanimous vote.

BRANDER MATTHEWS
COLUMBIA UNIVERSITY,
IN THE CITY OF NEW YORK,
May 14, 1914

THE NEW FUR SEAL INVESTIGATION

THE present Commissioner of Fisheries and Secretary of Commerce, having grown distrustful of past investigators, have arranged for a new fur-seal commission for the season of 1914. To those who have followed the fur-seal situation in the past few years this is a disappointment, delaying as it does for one season more the emancipation of the herd. Without wishing to prejudice the work of the new commission, but in simple justice to those whose work is thus put on trial, it seems fair to point out certain phases of the situation which confronts the new investigators.

By the law of 1912 commercial killing of fur seals is prohibited for five years. The object of any investigation at the present time must be to determine the wisdom or unwisdom, the necessity or lack of necessity, of this law. In effect the law was condemned eighteen years ago by the joint commission of American and British experts of 1896–7. The following words from the ninth paragraph of their joint agreement are worth quoting:

> The methods of driving and killing practised on the islands, as they have come under our observation during the past two seasons, call for no criticism or objection. An adequate supply of bulls is present on the rookeries; the number of older bachelors rejected in the drives during the period in question is such as to safeguard in the immediate future a similarly adequate supply; the breeding bulls, females, and pups on the breeding grounds are not disturbed; there is no evidence or sign of impairment of virility of males; the operations of driving and killing are conducted skillfully and without inhumanity.

This very positive conclusion was reached after two seasons of thorough study, involving the observation and inspection of drives aggregating 150,000 animals, 50,000 of which were killed. The commission of 1914 will have no opportunity whatever to observe the normal methods of land sealing, the law preventing it. The commission of 1896–7 had opportunity to carefully weigh and consider the action of pelagic sealing, in its judgment the sole cause of the herd's decline, determining the proportion of pregnant and nursing females in the catch on board the sealing vessels and observing the starvation of the dependent young on land. The new commission is entirely cut off from this source of information, the treaty of 1911 having suspended pelagic sealing. The new commission can obtain definite information from the rookeries of the present condition of the herd, but it will have no basis of comparison arising from previous experience, and can not, therefore, of itself determine whether the herd is increasing or diminishing.

Another difficulty confronts the new commission. It is said to "have been selected by outside agencies and to have no previous connection with the fur seal controversy." In other words it is a non-partisan commission.

The Secretary of Commerce has, however, taken pains to show that the issue is by no means a non-partisan one. On October 13, 1913, Secretary Redfield appeared before the House Committee on Expenditures in the Department of Commerce and thus expressed himself regarding the law of 1912: "I shall be glad to cooperate in any way within my lawful power or within the scope of my personal ability in carrying out to the spirit and to the letter what I regard as very wise legislation for the protection of our fur-seal herd." He even went further and announced to the committee that he had discharged the chief of the Alaska division of the Bureau of Fisheries and the naturalist of the fur-seal herd, because, forsooth, their "mental attitude" toward this law was not right. In other words, because these men believed the law was a mistake, they were disciplined.

The new commission is therefore in a dilemma. It must find the law of 1912 to be right or else to be wrong. In the one case, in a single season's work and with opportunity to get first-hand information on vital matters cut off, it must either review and turn down the work of an eminent body of men acting on unlimited data, or else it must contradict the expressed belief of the very authority under which the commission acts.

Meanwhile there hangs over the commission and its work a most heavy forfeit. The law of 1912, in so far as it prohibits the killing of male seals, was adjudged unnecessary eighteen years ago; the increase of 12½ per cent. in the stock of breeding seals in 1913, the second season under exemption from pelagic sealing, fully bears out this decision. The Secretary of Commerce has in his possession to-day adequate data to warrant the immediate repeal of the law. Such repeal now would permit of the resumption of normal land sealing in 1914 and the taking of the half million dollars' worth of sealskins which the hauling grounds of the Pribilof Islands stand ready to yield. We lost a like sum in 1913 through the operation of the law. The delay necessary to let the new commission make its report will inevitably repeat this loss. In short, the report of the commission will cost at a minimum $500,000, fifteen per cent. of which belongs to Canada, fifteen per cent. to Japan, and seventy per cent. to the treasury of the United States, under the treaty of July 7, 1911.

George Archibald Clark

The Preservation of Anthropoid Apes

To the Editor of Science: The suggestion of Professor Robert Yerkes in Science of May 1, that permanent stations should be established in tropical countries for the preservation of anthropoid apes in order that observations of value from a psychological standpoint be obtained, prompts me to urge the same thing on another and more important ground. As readers of Science doubtless know, the question of the etiology and the treatment in a number of diseases which have hitherto baffled investigators, probably will depend upon the use of these apes as objects of experimentation, and for this, if for nothing else their extinction should be prevented.

H. Gifford

Omaha, Neb.

Scientific Books

Clean Water and How to Get It. By Allen Hazen. Second Edition. New York, John Wiley & Sons. 1914. Pp. 181. $1.50.

Studies in Water Supply. By A. C. Houston. New York, Macmillan Co., Limited. Pp. 193. $1.60.

These two volumes may well be considered together, for they occupy the same general field, although their scope and method of treatment are quite different. Both authors are acknowledged experts in the subjects with which they deal.

Hazen's book is decidedly American in point of view and makes a strong case for the filtration of public water supplies as a means of protecting municipalities against typhoid and other forms of disease and for the improvement which can be so produced in the appearance, taste and odor of surface waters.

By some, the book will be regarded as too condensed to give a comprehensive knowledge of the many topics dealt with, but the

volume is not intended to be exhaustive. It is such a statement of the essential principles of American water purification practise as Mr. Hazen's large experience as a consulting engineer in this field has led him to believe would be useful to beginners. There is no better text-book for persons desiring a knowledge of water purification in the United States.

There are eighteen chapters in Mr. Hazen's book, including such topics as water supplies from rivers, lakes and wells; the history of water purification in the United States; storage of filtered water; use and measurement of water; suitable pressure to be supplied in water works systems; effect of iron pipes on water, and the layout of works. The subjects dealt with include sand filters, mechanical filters, coagulation basins and aeration.

The book is well-illustrated with half-tones and is produced with the usual excellence of the Wiley press. The first edition, published seven years ago, has been revised and expanded.

Houston, the bacteriologist and director of water examination of the Metropolitan Water Board of London, has produced a book in which he has explained his views as to the extent of the danger to be apprehended from polluted river water and how that danger is avoided without filtration by London, the largest and one of the healthiest cities in the world.

The American arguments which have been built up without opposition in the last twenty years and which seek to account for much of the excessive prevalence of typhoid in American cities as caused by polluted surface water are declared to be inconclusive and not in consonance with ascertainable facts.

Dr. Houston maintains that a watershed may be exposed to manifold pollution and the river draining from it impure, as judged by ordinary chemical and bacterial tests, but the water may nevertheless be shown to contain none, or scarcely any, of the microbes of water-borne diseases when tested by methods of proved value.

The American theory to the effect that the incidence of tuberculosis, pneumonia and other diseases not otherwise suspected of being water-borne can be greatly reduced by improving a public water supply is incredible to Dr. Houston.

The book is actually, but not formally, divided into two parts: The first tends to free the River Thames and the River Lee, which supply London with 80 per cent. of its drinking water, from the full gravity of the charge of being sewage-polluted rivers, and the second presents evidence that the self-purification process employed by London to prepare the water for consumption is uniformly efficient. There are eleven short chapters. The topics include water and disease; the financial value of pure water; sterilization processes; storage in relation to purification; the question of abstraction; sources of water; bacterial methods and much information about the remarkable water supplies for London over whose quality the author has had official supervision for many years.

GEORGE A. SOPER

NEW YORK CITY

Studies in Seeds and Fruits. An Investigation with the Balance. H. B. GUPPY. London: Williams and Norgate. 1912. Pp. xii + 528.

A careful reading of the research work, detailed in this volume, has abundantly repaid the reviewer. Guppy commenced the investigation, as a study of the rest-period of seeds, using in his research merely a sharp knife, pocket lens, balance and oven. The first chapter details the history of the investigation. The second chapter describes the three conditions of the seed, viz., the soft pre-resting seed, the contrasted, hard-resting seed and the soft, swollen seed on the eve of germination. Observations by means of the balance are made on seeds in all three of these stages. The third chapter is concerned with the impermeability of seeds and its significance, the fifth is a classification of seeds according to their permeability, or impermeability, while the sixth chapter gives additional evidence. The whole book is full of tables and is loaded with

detailed observations on such subjects as hygroscopicity, the régime of the shrinking and swelling seeds, the dehiscence of fruits, the proportion of parts in fruits, the abortion of ovules, seed coloration, the weight of the embryo, the rest-period of seeds and a philosophic chapter (XX.) on the cosmic adaptation of the seed in which the author states his belief that the seed is less specialized and less conditioned than the plant; that its potentialities present us with a range of life-conditions that extends beyond the earth and offers a clue to the conditions of existence in other worlds. Finally Guppy postulates a flora of the cosmos.

Although the author allows himself in the last chapter to be spirited away from things mundane, yet, the whole work is pervaded with the spirit of thorough scientific research in which no fact is overlooked which might bear on the main problem of seed investigation, and each fact is submitted to rigid examination, by the balance and other instruments of precision. The book has been overlooked apparently by other American botanic reviewers and it deserves a place on the shelves of any library that attempts to be stocked with recent important contributions to botanic science.

John W. Harshberger
University of Pennsylvania

SPECIAL ARTICLES

A NEW MARKING SYSTEM AND MEANS OF MEASURING MATHEMATICAL ABILITIES[1]

Perhaps the most noted methods of measuring the intelligence of young children are the De Sanctis and the Binet-Simon tests. These tests apply mainly to the measurement of lower levels of intelligence. It is very significant that the noted Italian and French psychologists who originated these tests did not extend the general method to be used with pupils of the secondary and higher schools. In the present state of educational psychology it does not seem practicable or possible to effect successfully such an extension; that is to say, it is improbable that such tests can be devised which can be applied to everyday use in our schools, and will be a real improvement upon our present system of examinations, in settling questions of promotion and in awarding honors in our high schools and colleges. We are able to determine certain questions of athletic proficiency by measuring the high jump or broad jump, by timing the quarter-mile or half-mile run. The fact that the candidate knows beforehand the nature of the test does not materially interfere with its efficiency. But if a candidate for promotion knows beforehand the exact nature of the test in algebra—as he easily may know, if tests are adopted to be used by all teachers at all times—then he can easily learn the few tests and make a high grade, even though his knowledge of the entire subject may be woefully deficient. It is quite evident that it is impossible to formulate specific questions in any branch of high-school mathematics, which could be used everywhere and at all times. Yet the report of the American Committee No. VII. on Examinations in Mathematics contains the following:[2]

> There seems to be a pronounced desire throughout the country for standardized tests in mathematics, that is, tests which will enable teachers to measure fairly accurately the efficiency of their instruction and to know whether their pupils are as proficient as those in other localities.

One way to meet this demand is to prepare a syllabus of essentials in high-school arithmetic, algebra and geometry, to be used in preparing the specific questions for an examination. Such a syllabus has its merits and also its demerits. Its merits are that both teachers and pupils have the territory to be covered by the examination more definitely limited to what are the essentials. Its demerits are that it leads both teachers and pupils to a disregard of the many minor facts of a science, which deserve at least passing notice.

[1] Read before the mathematics section of the Central Association of Science and Mathematics Teachers, November 29, 1913, at Des Moines, Iowa.

[2] U. S. Bureau of Educ., *Bulletin*, 1911, No. 8, p. 13.

Nor does the use of such a syllabus prevent the selection by one teacher of only easy exercises, and by another teacher of only hard exercises. It is my opinion that the value of a syllabus is overestimated, that our high-school text-books do not differ widely in the amount of material, nor in the degree of difficulty of the exercises contained therein. If a teacher carefully prepares a set of questions which, taken as a whole, are of average difficulty, he may rightly assume that he has a standard test. Notice my use of the word "carefully." No system of marking, however perfect, can be successful, if the teacher does not exercise *care*. A 12-inch disappearing gun will not defend Panama unless there is a careful eye to train it.

Granted that a standard set of questions is at hand, are our difficulties solved? Have we an absolute system of marking? By no means. Every one knows that two teachers seldom agree on the marking of the same examination paper. They differ often by 10 or 20, and sometimes even by 30 points on the scale of 100. Suppose a pupil in algebra makes a mistake in algebraic sign, but otherwise answers a question correctly. One teacher will attribute the error to mere oversight, and mark the question nearly perfect. Another teacher will be horrified at the ignorance of fundamentals, and will mark the same question nearly 0. Such discrepancies will arise even in the use of the Binet-Simon system. That system does not eliminate the lopsidedness of the examiner. One of the questions put to a child of ten is this: "What would you do if you were delayed in going to school?" Various replies may follow, as, for instance, "I would have to hurry," "I would have to run," "I would return home," "I would be punished," "The teacher would slap me," "I would not do it again." Do you believe that in such a variety of answers which children may give, any two examiners would agree in their markings? "I would be punished" does not answer the question. Accordingly, some examiners would mark 0. Other examiners would say that the reply not only implies that the question was properly understood, but that the child's mind passed beyond the immediate reply, that it "would have to hurry," and gave expression to a possible consequence that was more remote and therefore indicative of greater intellectuality. The diversity of estimates would be as conspicuous here as in any ordinary examination. As yet we are as far as ever from an accurate standard of marking.

But a more or less absolute standard of marking is the very thing we are after. We need a common mode of procedure, such that a mark of "excellent" in first-year geometry, given by a teacher this year, means nearly the same thing as a mark of "excellent" in this subject that will be given by a teacher twenty years from now. We need a system of marking such that a mark expressed in numbers conveys to every one a fairly uniform and definite idea of proficiency. During the last few years great progress has been made in devising plans toward achieving this end. What I shall present to you to-day contains little that is novel. In this matter I follow in the foot-steps of Cattell,[3] Colvin,[4] Dearborn,[5] Finkelstein,[6] Foster,[7] Hall,[8] Herschel,[9] Huey,[10] Judd,[11] Meyer,[12] Sargant,[13] Smith,[14] Steele,[15] Stevens,[16] Starch[17] and others.

[3] J. M. Cattell, *Popular Science Monthly*, Vol. 66, 1905, p. 367.

[4] S. S. Colvin, *Education*, Vol. 32, 1912, p. 560.

[5] W. F. Dearborn, *Bulletin of the University of Wisconsin*, 1910, No. 368.

[6] I. E. Finkelstein, "The Marking System in Theory and Practice," 1913.

[7] W. F. Foster, SCIENCE, Vol. 35, 1912, p. 887; *Popular Science Monthly*, Vol. 78, 1911, p. 388; "Administration of the College Curriculum," 1911, Chap. 13.

[8] W. S. Hall, *School of Science and Mathematics*, Vol. 6, 1906, p. 501.

[9] W. H. Herschel, *Bull. of Soc. from Prom. of Engineer. Education*, Vol. 3, 1913, p. 529.

[10] E. B. Huey, *Journal of Psycho-Asthenics*, Vol. 15, 1910, p. 31.

[11] C. H. Judd, *School Review*, Vol. 18, 1910, p. 460.

[12] M. Meyer, SCIENCE, Vol. 28, 1908, p. 243; Vol. 33, 1911, p. 661.

[13] E. B. Sargant, *Nature*, Vol. 70, 1904, p. 63.

[14] A. G. Smith, *Journal of Educational Psychology*, Vol. 2, 1911, p. 383.

Our scheme of measuring mathematical abilities resolves itself into two parts, as follows:

1. A formula for "arraying" students in order of ability, that is, for determining the relative positions of the members of a class, so as to establish the order of merit, or the rank of each individual in the group. This formula furnishes also preliminary estimates of ability.

2. A revision of these preliminary estimates so as to supplant them by an absolute standard.

Part I

Mathematical ability depends in part upon knowledge of a subject and proficiency in carrying on accurately the mechanical operations connected with it. This kind of ability may be determined by the usual memory tests conducted from day to day in the class-room, and at longer intervals by examination.

Mathematical ability is measured also by the success in solving original exercises. These tests are made in daily work, and also in final examinations.

The observation of instructors and the teachings of the history of science suggest a still further test of mathematical power, namely, the diligence or tenacity displayed by a pupil in pursuing his work. A pupil of only average talents, but of great tenacity of purpose, may achieve more in his life than a bright pupil of limited powers of application. A standard illustration is the case of Robert Mayer, who as a pupil made only a moderate record, but who, by his extraordinary tenacity of purpose was led to the discovery of the law of the conservation of energy.

In Germany and Switzerland this feature is being recognized in the records and reports of scholarship. When I was a boy I received two marks on every subject, one for *Fleiss,* or diligence, the other for *Fortgang,* or progress. In Germany this practise is in vogue to-day.

According to our scheme, the mathematical pupil is measured in three ways, as follows:

1. By memory tests
   - (*a*) In daily work.....*Ma*
   - (*b*) In examination.....*Mb*
2. By original exercises
   - (*a*) In daily work.....*Oa*
   - (*b*) In examinations.....*Ob*
3. By diligence (tenacity) shown.... *D*

How these marks should be combined might be a subject of legitimate debate. Following custom, we use the weighted arithmetic mean, as follows:

$$\text{Preliminary Mark} = \frac{M_a + rM_b + sO_a + tO_b + uD}{1 + r + s + t + u}$$

where r, s, t, u are coefficients determining relative weights. What weight should be given to daily work, what to the examination? In different schools the weights vary from daily work $\frac{1}{2}$, final examinations $\frac{1}{2}$, to daily work $\frac{1}{4}$ and final examination $\frac{3}{4}$. A conservative estimate would be to take $s = 1$, $r = t = u = \frac{1}{3}$.

Part II

After the relative place or rank of the students in a class has been determined by the process of Part I., we proceed to determine their marks on an absolute scale. We shall assume that the pupils constitute a random sample or "fair sample" of the student body. What is the distribution of mental ability, and of mathematical ability in particular? No one has been able to give a final answer to this question. Francis Galton, Karl Pearson and others have held that individuals differ from each other in ability in such a way as to conform with what is known as the "normal frequency curve" or the "normal curve" or the "Gaussian curve." Distances along the horizontal line measure the students' abilities. The corresponding ordinates of this bell-shaped curve indicate the frequency. In measuring physical characteristics, it is easy to tell whether or not the above curve represents the proper distribution. It is a singular fact that this curve has been found to represent a general biological

[15] A. G. Steele, *Pedagogical Seminary,* Vol. 18, 1911, p. 523.

[16] W. L. Stevens, *Popular Science Monthly,* Vol. 63, 1903, p. 312.

[17] D. Starch, *Psychol. Bulletin,* Vol. 10, 1913. p. 74; Science, Vol. 38, 1913, p. 630.

law of variation. Natural phenomena, as well as chance, tend to fluctuate in a manner indicated by this curve. Chest measurements on 5,738 soldiers[18] show the close agreement with theory. The stature of 1,052 English women[19] was found by Karl Pearson to closely obey the Gaussian law. Some of the lower mental traits can be measured in the psychological laboratory. Thorndike[20] found twelve-year-old pupils to be distributed according to the Gaussian curve as regards their accuracy and rapidity of perception. Memory tests yielded similar results. When it comes to tests of higher intellectual powers, records are discordant. Different examiners have varied to such a marked degree in marking the same individuals that conclusions can not be safely drawn from their estimates. On account of the presence of constant errors, the lopsidedness of individual markings can not be altogether eliminated by taking the averages of many grades from different examiners. A curve constructed from 1,487 grades in mathematics given by 19 different teachers in three high schools in Colorado exhibits two peaks with a valley between. The first peak is at 70 per cent., the passing mark; the other peak is just above 85 per cent. Evidently the peak at 70 per cent. is due to a constant error arising from the practise of raising marks of some pupils to the passing grade. Such constant errors arise also where a mark of 85 per cent. on the daily work exempts students from final examinations. It is found that in such cases medium grade students are advanced to the exempt limit. Seldom are marks given between 55 and 59, where 60 is the passing grade. If a doubtful student is finally passed, some teachers give him a mark considerably above passing, the idea being[21] that, if passed at all, he ought to be passed "handsomely." The tendency to mark high is inherent in human nature. Dr. Ruffner says:[22]

> A temporizing professor who loves popularity and desires, like the old man in the fable, to please everybody, is sure to be guilty of this fault, and, like many a politician, to sacrifice permanent good for temporary favor.

For these reasons, available statistics as to the distribution of mental abilities are inconclusive. Some empirical curves indicate considerable skewness, others follow the Gaussian curve. President Foster found that 8,969 grades in 21 elementary courses for two years at Harvard obeyed the normal curve of frequency. Dearborn makes similar reports for 472 high school pupils, also for freshman grades of these same pupils at the University of Wisconsin. It is doubtless the principle of continuity that has led not only English statisticians like Galton and Pearson, but also American investigators, Foster, Meyer, Smith, Dearborn, Finkelstein and others, to aver that the Gaussian curve or normal curve is the proper curve for the distribution of marks in school. In what follows we assume that the Gaussian curve can be so used.

The question then arises, what marks should be assigned to a random group or "fair sample" of, say, twenty students, whose order of rank is known by the tests suggested in Part I. This question involves some intricate statistical theory, which has been worked out by Karl Pearson. Pearson[23] states the problem thus:

> A random sample of n individuals is taken from a population of N members which when N is very large may be taken to obey any law of frequency expressed by the curve $y = N\phi(x)$, ydx being the total frequency of individuals with characters or organs lying between x and $x + dx$. It is required to find an expression for the average difference in character between the pth and the $(p+1)$th individual when the sample is arranged in order of magnitude of the character.

In answering this question, Pearson de-

[18] L. A. Quetelet, "Lettres sur la théorie des probabilités," p. 400. See also A. L. Bowley, "Elements of Statistics," London, 1902, p. 278; Dearborn, *op. cit.*, p. 8.

[19] Cattell, *op. cit.*, p. 371; Dearborn, *op. cit.*, p. 9.

[20] Thorndike, "Educational Psychology," p. 15.

[21] Finkelstein, *op. cit.*, p. 42.

[22] Quoted by Finkelstein, *op. cit.*, p. 47.

[23] Karl Pearson, "Note on Francis Galton's Problem," *Biometrica*, Vol. 1, pp. 390–399.

rives complicated formulas which we have used in calculating our data. Pearson himself felt that he had solved an important question, for he said:

AVERAGE DIFFERENTIAL ABILITIES OF PUPILS CHOSEN AT RANDOM[24]

Arbitrary Divisions	Class of 20		Class of 30		Class of 40		Class of 50		Class of 100	
	Rank	Mark/s	Rank	Mark/s	Rank	Mark/s	Rank	Mark/s	Rank	Mark/s[25]
Excellent Above +1.5	1	1.9	1	2.1	1	2.2	1	2.3	1	2.5
			2	1.6	2	1.8	2	1.9	2	2.2
					3	1.5+	3	1.6	3	2.0
									4	1.8
									5	1.7
									6	1.6
									7	1.5+
Superior +.5+ to +1.5	2	1.4	3	1.4	4	1.4	4	1.5	8, 9	1.4
	3	1.1	4	1.2	5	1.2	5	1.3	10, 11	1.3
	4	.9	5	1.0	6	1.1	6	1.2	12, 13	1.2
	5	.8	6	.9	7	1.0	7	1.1	14, 15	1.1
	6	.6	7	.8	8	.9	8, 9	1.0	16, 17	1.0
			8	.7	9	.8	10	.9	18–20	.9
			9	.6	10	.7	11	.8	21–23	.8
					11	.6	12, 13	.7	24–26	.7
					12	.6	14	.6	27–29	.6
							15	.6	30, 31	.5+
Medium −.5 to +.5	7	.5	10	.5	13	.5	16	.5	32, 33	.5
	8	.3	11	.4	14, 15	.4	17, 18	.4	34–36	.4
	9	.2	12	.3	16	.3	19, 20	.3	37–40	.3
	10	.06	13	.2	17, 18	.2	21, 22	.2	41–44	.2
			14	.1	19	.1	23, 24	.1	45–48	.1
			15	.04	20	.03	25	.02	50	.01
			16	− .04	21	− .03	26	− .02	51	− .01
	11	− .06	17	− .1	22	− .1	27, 28	− .1	53–56	− .1
	12	− .2	18	− .2	23, 24	− .2	29, 30	− .2	57–60	− .2
	13	− .3	19	− .3	25	− .3	31, 32	− .3	61–64	− .3
	14	− .5	20	− .4	26, 27	− .4	33, 34	− .4	65–67	− .4
			21	− .5	28	− .5	35	− .5	68, 69	− .5
Inferior −1.5 to −.5+	15	− .6	22	− .6	29	− .6	36	− .6	70, 71	− .5+
	16	− .8	23	− .7	30	− .6	37	− .6	72–74	− .6
	17	− .9	24	− .8	31	− .7	38, 39	− .7	75–77	− .7
	18	−1.1	25	− .9	32	− .8	40	− .8	78–80	− .8
	19	−1.4	26	−1.0	33	− .9	41	− .9	81–83	− .9
			27	−1.2	34	−1.0	42, 43	−1.0	84, 85	−1.0
			28	−1.4	35	−1.1	44	−1.1	86, 87	−1.1
					36	−1.2	45	−1.2	88, 89	−1.2
					37	−1.4	46	−1.3	90, 91	−1.3
							47	−1.5	92, 93	−1.4
Poor Below −1.5									94	−1.5+
									95	−1.6
									96	−1.7
									97	−1.8
					38	−1.5 +	48	−1.6	98	−2.0
			29	−1.6	39	−1.8	49	−1.9	99	−2.2
	20	−1.9	30	−2.1	40	−2.2	50	−2.3	100	−2.5

[24] For practical use this table should be considerably extended.

[25] The marks for a class of 100 are adapted from the tables of H. L. Moore's "Laws of Wages," New York, 1911, pp. 98, 99. Moore computed his table to six decimals. He applies Pearson's statistical theory to the study of "wages and ability."

This difference problem marks a new and very probably most important departure in statistical theory.

Clearly a knowledge of the average difference in scholarship of adjacent individuals supplied by Pearson's formulas involves also a knowledge of the average difference in scholarship between any two individuals. We shall display in our tables the difference between the modal or most frequent scholarship of the class and the scholarship of any individual in the class.

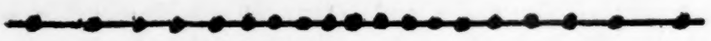

FIG. 1.

The columns headed "mark/s" signify the ability of the pupil above or below the modal ability, divided by s, the standard deviation of the total group of students (say first year high school students) from which the particular class is taken at random as a "fair sample." It will be noticed that a large standard deviation indicates a large range of distribution—that is, a large difference of accomplishment between the best and poorest in the class. In freshman classes the standard deviation is apt to be large, because of great difference in preparation. For our purposes, the exact value of the standard deviation is of no interest. We are concerned more with the ratios of differential abilities than with their absolute values. Hence we shall take $s=1$, or, if more convenient, $s=10$.

Consider a class of 20 pupils. The modal or "mediocre" ability is taken here, as in the other cases, as the standard of reference and is marked 0. Abilities of students are arranged symmetrically above and below, and marked positive and negative. By subtracting the ability of a pupil of rank n from that of his neighbor below, we get the differential ability of the two. In a class of twenty the difference in average ability between the tenth and eleventh pupil is .13. The difference between the first and second pupil is .5. Thus the difference between the first and second pupils is about four times greater than the difference between the tenth and eleventh. Similar statements apply to the poorest pupil and the one next above him. These relations are brought out by the adjoining figure.

Distances measured to the right and left of the zero point signify abilities above and below the modal ability. The relative standings of the members of an average class of 20 are indicated by the dots. Observe the denseness of the dots near the modal position and the isolation of those at the ends.

When the number of pupils in a class is larger, the differential ability of the pupils ranking next to each other becomes smaller. Thus in a class of 100, the difference between the first and second is on an average .3, that between the 50th and 51st is on an average .02, but the former difference is about 15 times greater than the second. The importance of these relations is brought out by Pearson in the following words:

> It is not possible to pass over the general bearing of such results on human relations. If we define "individuality" as difference in character between a man and his compeers, we see how immensely individuality is emphasized as we pass from the average or modal individuals to the exceptional man. Differences in ability, in power to create, to discover, to rule men, do not go by uniform stages. We know this by experience, but we see it here as a direct consequence of statistical theory, flowing from a characteristic and familiar chance distribution. We ought not to be surprised, as we frequently are, at the results of competitive examination, where the difference in marks between the first men is so much greater than occurs between men towards the middle of the list. In the same way the individuality of imbeciles and criminals at the other end of the intellectual and moral scales receives its due statistical appreciation.

The total range of distribution for classes of random pupils not exceeding 100 is about $2.5s$ on each side of the modal line, where s is the standard deviation. Taking $s=1$ or $s=10$ we have a scale for marking, the objec-

tion to which lies mainly in the fact that it is new. But this scale is the most scientific yet proposed. It is based on careful, statistical theory.

The mode of distribution of mental abilities, exhibited in the normal curve, suggests that the scale be subdivided into an odd number of parts, so that there may be a central group, representing average students, which is the most common type of students. The other groups are placed symmetrically above and below this central group. What should be the total number of groups? Experience shows that three groups are hardly sufficient, that seven groups are excessive. The five-group system is altogether in nearest accord with experience. Accordingly, we shall use the terms "Excellent," "Superior," "Medium," "Inferior," "Poor," and define their positions on the Pearson scale, thus:

Poor	Inferior	Medium	Superior	Excellent
Below -1.5	-1.5 to $-.5+$	$-.5$ to $+.5$	$.5+$ to $+1.5$	Above $+1.5$

When a class of 20, 30 or 40 pupils has to be marked, we first determine the ranks of the pupils. Then the numerical values of these tables are a suggestion as to the probable marks to be assigned. For any one class of 20 these tabular figures are, of course, not binding. If a large number of different classes of 20 could be marked with absolute accuracy, the *averages* of the marks of all the pupils that take the rank n in the lists of twenties would yield the values given in the tables. Thus the averages of the students ranked fifth in different classes of twenty students each, is .8. What deviation from the tabular marks should be made in the case of any particular class because of its individual variation or its deviation from a "fair sample" must lie with the judgment of the instructor. The position of the exact line of cleavage between pupils "passing" and those "not passing" must rest with him. It is my own judgment that, *if teachers were to follow very closely the tabular marks, and were to modify them in only exceptional cases, and then only slightly, that a great stride would be taken toward a scientific and absolute method of marking.* Gross irregularities in marking, such as Finkelstein has found in Cornell, and such as we know to exist in schools with which we are connected—irregularities working great injustice to pupils aspiring to honors and to scholarships—would be eliminated by the adoption of a plan as herein set forth. Every one knows that the marking system as carried on at present in high schools and colleges is a farce. But the adoption of a scheme of marking as here proposed would show that a mark of 0 places the pupil in a modal position, as a mediocre student. A mark above 1.5 places him in the list of the very few branded "excellent." A mark below -1.5 places him near the line of students marked "not passed."

In nearly all the marking systems that have been suggested in recent years, the recommendation is made that, under normal conditions, a certain percentage of the class be marked "excellent," another percentage "superior," etc. The Missouri plan involves the same idea by dividing each class of 100 into four groups of 25 students each, and then subdividing the first and last groups again into two classes. I have never seen it pointed out that *such a procedure, as a matter of fact, rests upon an unsound basis.* The tabular data computed from Pearson's formulas show that if, for instance, we mark 7 per cent. of a class of 100 "excellent," we have a different standard of "excellence" from what we have when 7 per cent. of a class of 50 is marked "excellent." The difference in standard is slight, but it exists, and therefore renders the percentage basis scientifically objectionable. To illustrate: When 7 per cent. of the class are marked "excellent," the lower limit for this mark on the Pearson scale is (using more accurate results than those in our table) 1.4390 for a class of 100, 1.4045 for a class of 50, 1.3951 for a class of 40, 1.3529 for a class of 30, and 1.3080 for a class of 20. Seven per cent. of a class of 41 members is four, but only three of the four stand above the point 1.4390

on the Pearson scale. In other words, on the 7 per cent. basis of excellence, the grade "excellent" is easier to reach in a small class than in a large one. If a class is divided arbitrarily into four groups, equal in number, as in the Missouri system, then the lower limit of merit for the top group is .6588 for a class of 100, .6368 for a class of 40, and .5972 for a class of 20. Twenty-five per cent. of a class of 51 members is 13, but only 12 of these have a mark above .6588 on the Pearson scale. Such variability of standards does violence to our sense of scientific rigor, though the practical results do not usually differ, owing to the fact that in practise only integral numbers apply.

In a scientific marking system the first requisite is uniformity of standards of reference. Lack of uniformity is sufficient reason for rejecting the classification into groups on the percentage basis, as in the Missouri system and others, unless that basis has some advantages which compensate for its theoretical defects. Such advantages it is difficult to discover.

To summarize, our proposed plan of marking is as follows:

1. A system of preliminary marking is used, merely to determine the rank of the students.

2. After the rank is fixed, each student is assigned the marks given in our table, with such slight modifications of the marks as are necessary in the judgment of the instructor.

The advantages of this system are:

1. It rests upon correct statistical theory.

2. The groups called "superior," "medium," "inferior" cover equal ranges of ability. These ranges are constant, no matter what the size of the class may be. Neither the top group called "excellent," nor the bottom group called "poor" has a fixed extreme limit, thereby providing, as the system should, for the grading of men of genius at one end and of the intellectual sluggards at the other.

3. It tends to eliminate the personal equation of the examiner.

4. The method is absolute, except in the determination of the deviations of the marks of a class from the *average* marks of classes of that size.

"This is a complicated system," you will say. So it is, though not quite so complex, perhaps, as it appears at first sight. Chemists and physicists know that any process of exact measurements requires time, patience and skill. That is true of our plan.

FLORIAN CAJORI

COLORADO COLLEGE,
COLORADO SPRINGS

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION B—PHYSICS

SECTION B—Physics—of the American Association for the Advancement of Science held its meetings jointly with the American Physical Society during the convocation week beginning December 29, 1913, at the Georgia School of Technology.

Professor Anthony Zeleny, of the University of Minnesota, was elected vice-president of the section for the ensuing year. There were also elected to the Sectional Committee, Professor D. C. Miller, Case School of Applied Science, 4 years, and Professor G. W. Stewart, University of Iowa, 5 years.

As customary in the past all the shorter and more technical physical papers were given under the auspices of the American Physical Society. On the other hand the longer papers, and, in this case, those that dealt especially with geophysical problems, were grouped together and given under the auspices of Section B. These were:

The Methods of Physical Science, to What are They Applicable?: ARTHUR G. WEBSTER.

This was the vice-presidential address, and is given in full in SCIENCE, 39, pp. 42–51, 1914.

The Present Status of the Magnetic Survey of the Earth: L. A. BAUER.

A concise summary was given in this paper of some of the more important investigations undertaken, and conclusions reached, by the department of terrestrial magnetism of the Carnegie Institution of Washington. The great progress of the magnetic survey of the earth, as conducted by this institution, both over land and over water, was shown on a projected map. Many thousands of miles, even hundreds of thousands, have been traversed in obtaining the data necessary to the accurate magnetic mapping of the earth; nor were the routes followed along the safe and beaten tracks of travel, but rather across the least fre-

quented and even the more dangerous regions, and yet, in spite of the great distances travelled and all the excessive difficulties encountered, the entire survey has thus far been made without the occurrence of a single fatal accident.

Isostacy and the Size and Shape of the Earth: William Bowie.

The determination of the size and shape of the earth would be a simple matter if its geoid or sea-level surface formed a geometrical figure, but as it does not the actual problem is a difficult one. These deviations, it was shown, are due to differences in the vertical distribution of mass in adjacent isostatic regions. When corrections for the effects of topography and isostatic compensation are applied to the astronomically observed positions the deviation of the geoid from the spheroid surface is largely eliminated.

The shape but not the size of the earth may be determined from the observed values of the force of gravity at stations widely separated in latitude. Here again a correction for topography and isostatic compensation is necessary for the best results. Absolute values of gravity can be obtained only with a long series of observations, and therefore nearly all gravity determinations are made by the relative method. Those of the Coast and Geodetic Survey are based on the absolute value at Potsdam.

Investigations made by the U. S. Coast and Geodetic Survey during recent years show that the area of the United States, taken as a whole, is in a state of perfect isostacy, and that areas of limited extent deviate only slightly from that state. The paper will later appear in full.

Seismology: Otto Klotz.

The most improved seismological apparatus, the data obtained by them and the conclusions logically deduced from this data were all discussed at some length. A full and interesting account, together with many illustrations, was given of a recent installation of seismological apparatus that registers in magnified form even those small vibrations of the earth's crust caused by the passage of ocean waves.

The Factors of Climatic Control: W. J. Humphreys.

It was explained that such things as land elevation, oceanic circulation and volcanic dust in the high atmosphere are among the most important factors of climatic control, assuming of course approximate constancy of atmospheric composition and solar radiation.

Both the direct or primary and the indirect or secondary effects of each of these factors were explained in some detail and illustrated by statistical curves.

It is expected that the paper will later appear in full.

There was also one joint meeting with Section C—Chemistry, at which the following papers were presented:

Geochemical Research: John Johnston.

A general account of some of the main lines of geochemical work which are now being pursued in the geophysical laboratory of the Carnegie Institution.

The Ternary System Lime-Alumina-Silica: G. A. Rankin.

The author discussed the results of an extended investigation of this system, which is important from a geological standpoint as well as from the fact that these three oxides are the essential ingredients in the manufacture of portland cement clinker. The fields of stability of all the substances which may be encountered in this system have now been determined satisfactorily; so that it is now possible to state precisely what happens when any mixture of the above three oxides is heated, and hence incidentally to specify the essential constituents of portland cement clinker.

W. J. Humphreys,
Secretary of Section B

SOCIETIES AND ACADEMIES

ACADEMY OF SCIENCES OF ST. LOUIS

At a meeting held June 1, Professor Nipher gave a brief account of a new method of decomposing water.

A continuous discharge from electrodes in separate beakers was made to pass through a capillary tube, forming a siphon connecting the water in the two beakers, water was decomposed at the electrodes and within the siphon. More than 50 times as much explosive gas was discharged from the siphon as was collected in the tubes around the electrodes. Distilled water which had been freshly boiled was used.

A full account of this result will be given in a volume now in the hands of the publisher, which will give a full account of the results of Professor Nipher's experimental work during the last five years.

C. H. Danforth,
Secretary